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HYDROLOGIC BULLETIN NO. 5 ISSUED 1942

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THE AGRICULTURE, SOILS, GEOLOGY, AND TOPOGRAPHY OF THE BLACKLANDS EXPERIMENTAL WATERSHED WACO, TEXAS

BY

HYDROLOGIC DIVISION
OFFICE OF RESEARCH
SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE WASHINGTON, D. C.

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CONTENTS

	Page
Introduction	1
Hydrologic research program of the Soil Conservation Service	2
Location and physiography	2
Geology and soils	8
Climate	9
Agriculture	10
Farming practices	11
The conservation survey	13
Methods and definitions	13
Soil groups	13
Watershed characteristics	16
Experimental equipment	33
Appendix:	
Description of soil types	35
Topographic maps	Inside back cover

PLATES

Plate	Facing page
1. *A*, Typical terrain in the Brushy Creek watershed. *B*, Bedding a field before planting cotton. This field had previously been center-furrowed following the harvest of the corn crop	12
2. *A*, Cracks in the face of a gully in Houston black clay. Note the slaked soil that has caved from the face of the gully as it dried. *B*, Another view of the gully in *A*, showing the process by which destructive erosion occurs once a gully has been formed. The columns of soil in the bottom of the gully broke away from its face when rain entered the cracks and loosened the material attaching the columns. The next rain causing run-off will carry the material away, together with material from other columns caving at the time of the rain. *C*, View of the gully in *A* and *B* at a later date following approximately 3 inches of rain that wet the surface soil and closed the cracks in the surface but not those in the subsurface. The photograph was taken the day following the rain. *D*, Dry-weather cracks in Houston black clay. *E*, Depressions in Houston black clay on the tops of hills in virgin grassland. *F*, Virgin prairie grass on Houston-Hunt clay. Note the uneven surface. The ridges are Houston clay and the depressions Hunt clay	13
3. *A*, H-1 flume and Ramser silt sampler at ¼-acre plot P4. The concrete collecting gutters and the flume and flume-approach section have since been covered to eliminate from the record the run-off from rain falling on these impervious areas. *B*, H-3 flume, Ramser silt sampler, and gutter covers at 3-acre watershed 7. In the foreground are cotton plants. *C*, 5-foot modified Parshall flume with 1-on-5 Columbus weir at station Y-2, looking upstream	32
4. *A*, Looking upstream at the low-water control, channel, recorder shelter, and footbridge at station J. Run-off from 5,860 acres passes this station. *B*, Looking upstream at the low-water control, channel, recorder shelter, and footbridge at station C. Run-off from 579 acres passes this station. *C*, Typical installation for recording fluctuations of the ground-water level at well 663	33

PLATES—Continued

	Facing page
5. *A*, Rain gages, anemometer, soil thermograph, and instrument shelters at station 14; *B*, recording and standard nonrecording rain gages at station 82	33

MAPS AND CHARTS

Figure	Page
1. Research activities of the Hydrologic Division of the Soil Conservation Service	3
2. Location of the Blacklands Experimental Watershed and areal extent of the major geologic formations in the main Blackland prairie	4
3. Soils of the Blackland prairies of Texas	5
4. Location of run-off measuring stations, rain gages, and ground-water wells in the Brushy Creek drainage basin	6
5. Location of run-off measuring stations, rain gages, and ground-water wells on the Government land	7
6. Topography and soil, watershed 2	20
7. Topography and soil, watershed 3	21
8. Topography and soil, watershed 5	22
9. Topography and soil, watershed 6	23
10. Topography and soil, watershed 7	24
11. Topography and soil, watershed 11	25
12. Topography and soil, watershed 12	26
13. Topography and soil, watershed 13	27
14. Topography and soil, watershed 14	28
15. Topography and soil, watershed 16	29
16. Topography and soil, watershed 17	30
17. Topography and soil, watershed 18	31
18. Topography and soil, plots P1, P2, P3, and P4	32

TABLES

Table	Page
1. Monthly, seasonal, and annual temperature and precipitation at Waco, McLennan County, Tex	10
2. Land use and crop distribution, 1937	11
3. Soil depth corresponding to each class of sheet erosion	14
4. Watershed characteristics	17
5. Soil types and average depth of soil in watersheds A, C, D, G, and J	17
6. Soil types and average depth of soil in watersheds Z, Y, and W, and the watersheds lying within Y and W	18
7. Percentage of each large watershed in each erosion class	18
8. Percentage of watersheds A, C, D, G, and J in each land separation	19
9. Percentage of watersheds Z, Y, and W in each land separation	19
10. Instrumentation on each watershed, December 31, 1940	33

UNITED STATES DEPARTMENT OF AGRICULTURE
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By *Hydrologic Division, Office of Research, Soil Conservation Service*

INTRODUCTION

This bulletin presents a brief history and a detailed description of the Blacklands Experimental Watershed near Waco, Tex., which is one of several similar projects in the United States at which hydrologic problems as affected by agricultural practices within the field of the Soil Conservation Service are being studied. The physical features, the land use before the work of the Soil Conservation Service on the area, and the instrumentation as of December 31, 1940, are described. There is also a general description of the Blackland prairies.

The description of the watersheds presented herein is necessary to the interpretation of hydrologic data as they are published. Data from the Blacklands Experimental Watershed have been presented in three publications.[1] This description and the data will furnish the basis for the analyses and conclusions appearing in later bulletins. They will be of value in the various action programs of the Department of Agriculture and also in the flood-control activities carried on cooperatively by the War Department and the Department of Agriculture. The War Department also has need for such information in dealing with run-off in army camps and airports and in directing

[1] POTTER, W. D. and BLANK, HORACE R. BLACKLANDS EXPERIMENTAL WATERSHED GROUND-WATER GRAPHS, 1936-37. U. S. Soil Conservation Serv. SCS-TP-24, [44] pp., illus. 1939. [Mimeographed.]; HYDROLOGIC DIVISION, SOIL CONSERVATION SERVICE. HYDROLOGIC DATA, BLACKLANDS EXPERIMENTAL WATERSHED, WACO, TEXAS. U. S. Dept. Agri. Hydrol. Bul. 2, 197 pp. illus. 1941. BLANK, H. R.; STOLTENBERG, N. L.; and EMMERICH, H. H. GEOLOGY OF THE BLACKLANDS EXPERIMENTAL WATERSHED. U. S. Soil Conservation Serv. SCS-TP-49. 1942. [Mimeographed.]

ACKNOWLEDGMENTS.—The work on this experimental-watershed project is being done in cooperation with the Texas Agricultural Experiment Station, A. B. Conner, director, E. B. Reynolds, chief, Division of Agronomy. Other cooperators under formal agreement are the United States Weather Bureau and the United States Bureau of Entomology and Plant Quarantine, Division of Cotton Insect Damage, R. W. Harned, in charge, K. P. Ewing, entomologist. Valuable assistance has been rendered by the United States Geological Survey; the Texas Board of Water Engineers; the School of Engineering, the Division of Geology and the Bureau of Economic Geology of the University of Texas; the Brazos River Conservation and Reclamation District; the Brazos River Soil Conservation Association; the highway departments of McLennan and Falls Counties, Tex.; the city of Temple, Tex.; the department of health, Waco, Tex.; the Chambers of Commerce of Waco, Marlin, Mart, Riesel, and Perry, Tex.: and by the several landowners in the experimental watershed.

The selection of the site for the Blacklands Experimental watershed, the topographic survey, and the early preliminary work were done under the field direction of D. B. Krimgold. The data for this bulletin were collected in the field under the supervision of R. W. Baird, project supervisor. The conservation survey was made under the direction of C. W. Lauritzen, assisted by A. J. Stewart of the project staff and W. D. Shrader and A. L. Trowbridge of the Physical Surveys Division. The detailed topographic survey was made by L. A. Westby, J. T. O'Brien, A. J. Polos, O. F. Weymouth, and S. D. McElroy. The geologic survey was made by H. R. Blank, H. H. Emmerich, and N. L. Stoltenberg. The design and construction of the stations for measuring surface run-off and the installation of meteorological equipment were under the direction of D. S. Jenkins. Equipment for measuring ground water elevations was installed under the direction of H. R. Blank. The design and construction of utilities and roads at project headquarters were under the supervision of G. E. Byars. The assembly of data and preparation of the report were largely the work of C. W. Lauritzen. The Brazos Conservation and Reclamation District furnished the aerial photographs used in the conservation survey. They also prepared the planimetric sheets from these photographs, using the ground-control survey made by L. M. Kennison of the Cartographic Division of the Soil Conservation Service. The conservation survey was inspected by Earl D. Fowler of the Division of Physical Surveys, Soil Conservation Service, and W. T. Carter, Soil Survey Division, Bureau of Plant Industry. General direction for the collection and preparation of the data originated from W. U. Gartska, L. L. Harrold, and the late H. R. Leach, of the Washington Office, Hydrologic Division, C. E. Ramser, chief.

reservoir operations on existing power and navigation projects. Engineers of the Public Roads Administration and State highway departments have use for it in designing road culverts, weirs for check dams, and roadside and diversion ditches. Municipal engineers can use such information in planning water supplies for cities, in providing for run-off from suburban areas tributary to storm sewers and streams, and in solving many other drainage and erosion problems arising on park and airport projects. Railroads and other utilities have need for this information in water-supply, drainage, and erosion work.

Available data for these uses are extremely meager. Without such data it is impossible to make accurate estimates of the magnitude of the run-off which must be handled by channels, spillways, check dams, culverts, stock ponds, storm-water sewers, and other hydraulic works. The lack of dependable information on run-off often results in the complete failure of such works. Even more frequently perhaps, insufficient information leads to the use of unnecessarily high factors of safety in the design of structures, and thus to unjustifiably high costs.

HYDROLOGIC RESEARCH PROGRAM OF THE SOIL CONSERVATION SERVICE

A knowledge of the influence of land use practices and soil characteristics on the run-off and erosion from complete natural watersheds is essential in planning watershed-improvement programs directed toward the conservation of soil, the reduction of floods, the better use of water resources, and the attainment of a balanced agricultural economy. As a part of the Soil Conservation Service research program designed to provide these data, the Hydrologic Division was organized and provision made for establishing a number of experimental watersheds. The Blacklands of Texas was selected as an area in which one of these watersheds would be located. Others are located in the North Appalachian region, near Coshocton, Ohio, and in the Great Plains region, near Hastings, Nebr. The nature of the studies to be made at these experimental watersheds is indicated in a report of the Chief of the Soil Conservation Service,[2] in which the objectives and problems involved in these studies are stated as follows:

(1) To determine quantitatively the effect of improved land-use and erosion-control practices on soil and water conservation, and the extent to which these improved practices are effective in the control and reduction of floods and in sustaining and augmenting dry-weather stream flow, (2) to collect and interpret data on rates and amounts of run-off resulting from rains of various amounts and intensities on agricultural areas ranging in size from small natural watersheds to those covering 5 to 6 thousand acres.

The problem on the experimental watersheds consists of a detailed and comprehensive study of the action of water from the time it reaches the ground surface as precipitation until it leaves the watershed as surface or underground flow. It includes studies of precipitation, interception, percolation, evaporation, transpiration, surface and underground storage, and rates of land-surface, channel, and underground flow. Contingent upon future developments, the general plan of study consists of (1) evaluating all factors affecting run-off by carefully conducted experimental studies, and (2) tracing the influence of such factors from small to large watersheds.

The program of research at the experimental watersheds is designed to develop methods of utilizing data obtained on plots and small watersheds in predicting the effect of land use changes over extensive areas, which may include a wide range of soils and topographic features.

In addition to these three large experimental watersheds, small groups of watersheds in important agricultural areas have been selected for the purpose of obtaining rates and amounts of rainfall and run-off for use in the economic design of erosion and flood-control measures and of hydraulic structures. The locations of hydrologic research activities of the Hydrologic Division of the Soil Conservation Service are shown in figure 1.

[2] BENNETT, H. H. REPORT OF THE CHIEF OF SOIL CONSERVATION SERVICE, 1937. U. S. Dept. Agr., Soil Conservation Serv. Ann. Rpt., 52 pp. 1937. See p. 37.

LOCATION AND PHYSIOGRAPHY [3]

The Blacklands Experimental Watershed lies in the Gulf Coastal Plain in the geographic division known as the Blacklands or the Blackland prairies (fig. 2). The main Blackland prairie is a wedge-shaped treeless area in eastern Texas where black soils predominate. It comprises about 9,000,000 acres and extends in a southwesterly direction for over 300 miles from a few miles south of the Red River boundary of Texas to the Rio Grande Plain a few miles northeast of San Antonio. This main prairie narrows from a width 75 miles in the north to about 20 miles in the south and occupies parts or all of 31 counties. To the southeast are similar minor Blackland prairies that cover 2,000,000 acres in parts of 15 counties (fig. 3). Not all of these smaller areas are prairie; within them are many small areas of timber.

The experimental area lies in about the center of the main Blackland prairie in McLennan and Falls Counties, 16 miles southeast of Waco, Tex., between

[3] The material for the discussion of the Blacklands was obtained from numerous sources, chief of which are: CARTER, W. T. THE SOILS OF TEXAS. Tex. Dept. Agr. Bul. 7, 77 pp., illus. 1909; GEIB, H. V. and GODDARD, IRA T. RECONNAISSANCE EROSION SURVEY OF THE BRAZOS RIVER WATERSHED, TEXAS. U. S. Dept. Agr. Mis. Pub. 186, 47 pp., illus. 1934; SELLARDS, E. H., ADKINS, W. S., and PLUMMER, F. B. THE GEOLOGY OF TEXAS. 2 v., illus. Austin, Tex. 1932. (Tex. Univ. Bul. 3232); and published soil surveys and erosion surveys of areas in the Blacklands.

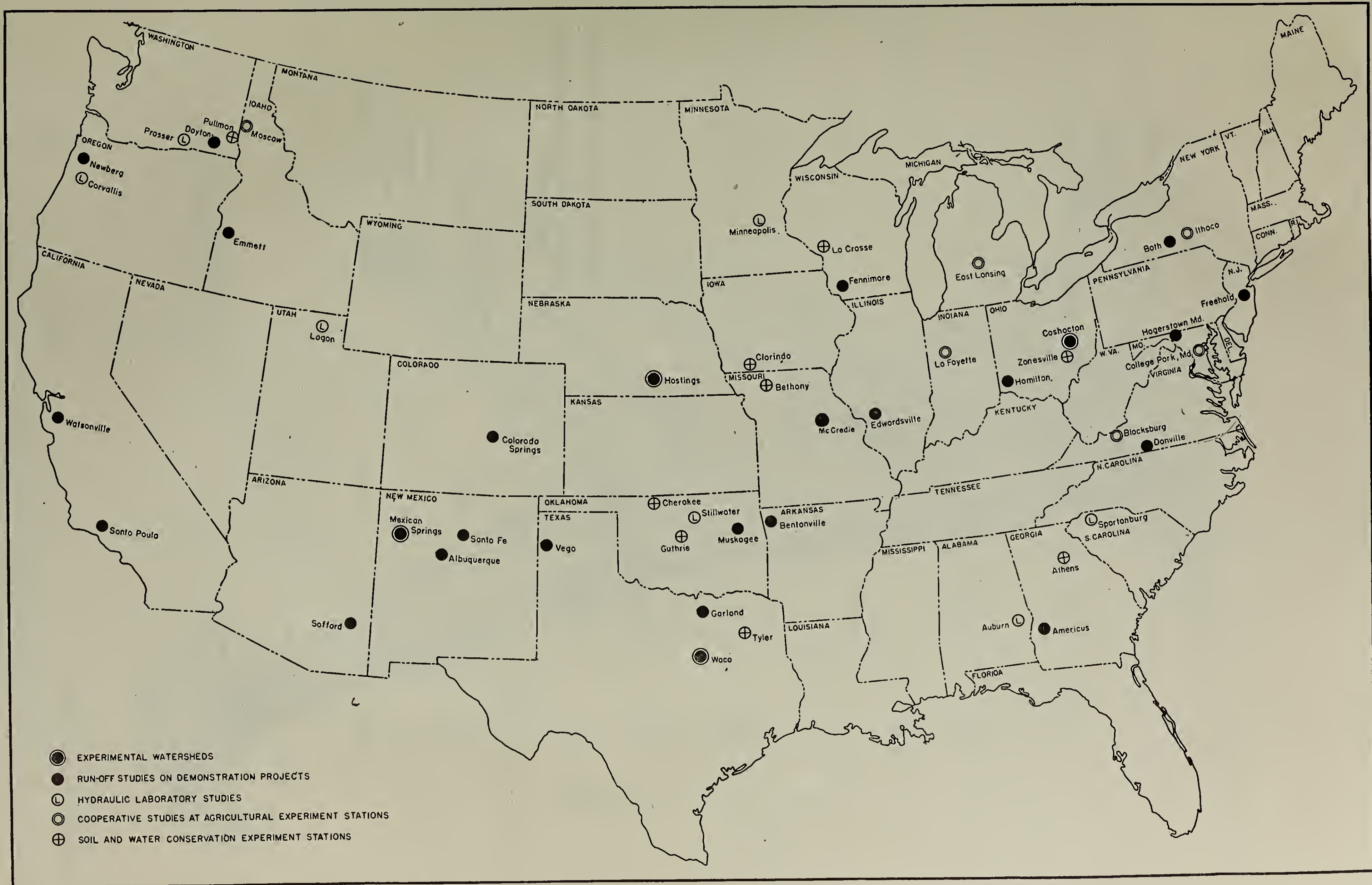

FIGURE 1.—Research activities of the Hydrologic Division of the Soil Conservation Service.

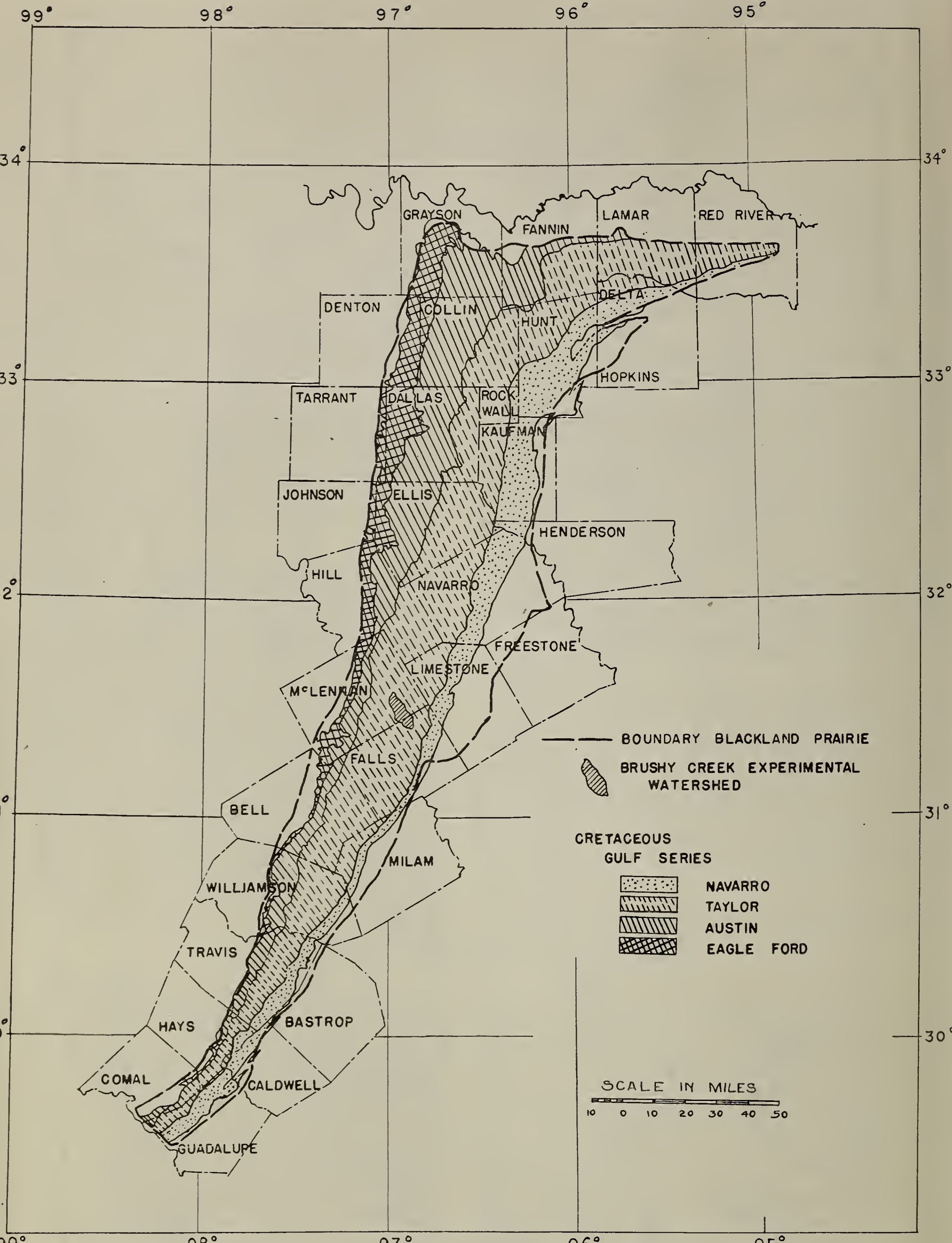

FIGURE 2.—Location of the Blacklands Experimental Watershed and areal extent of the major geologic formations in the main Blackland prairie.

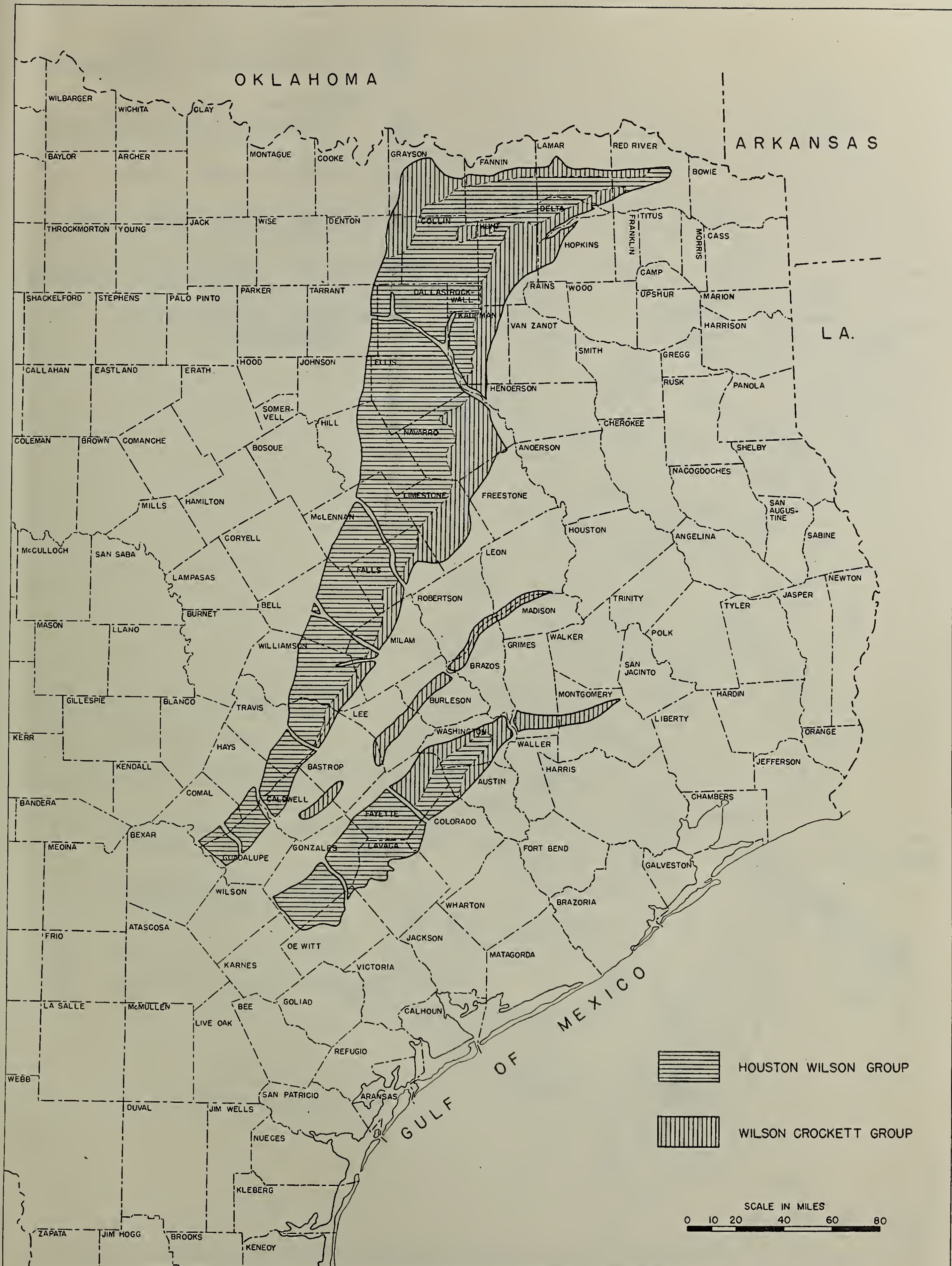

FIGURE 3.—Soils of the Blackland prairies of Texas.

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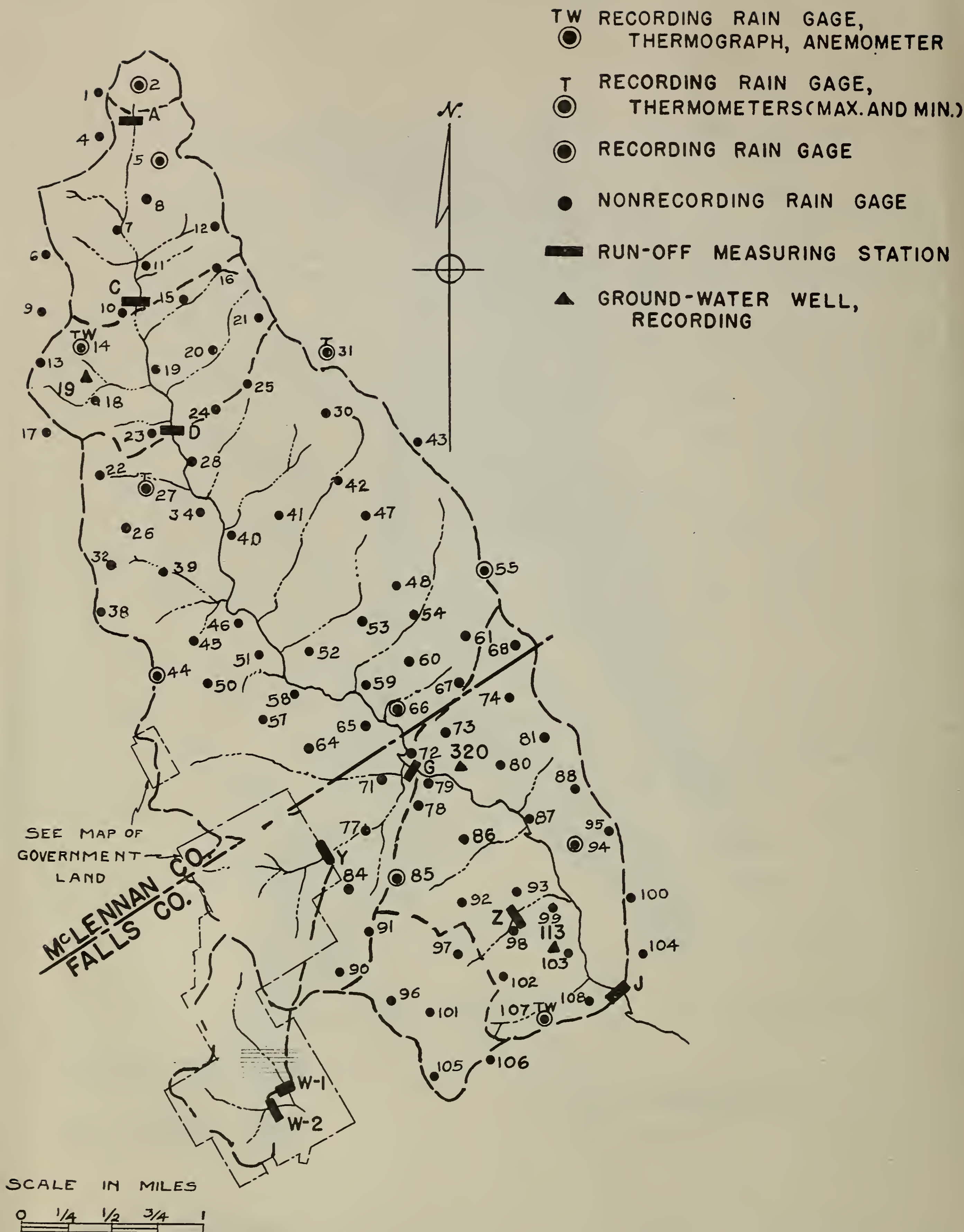

FIGURE 4.—Location of run-off measuring stations, rain gages, and ground-water wells in the Brushy Creek drainage basin.

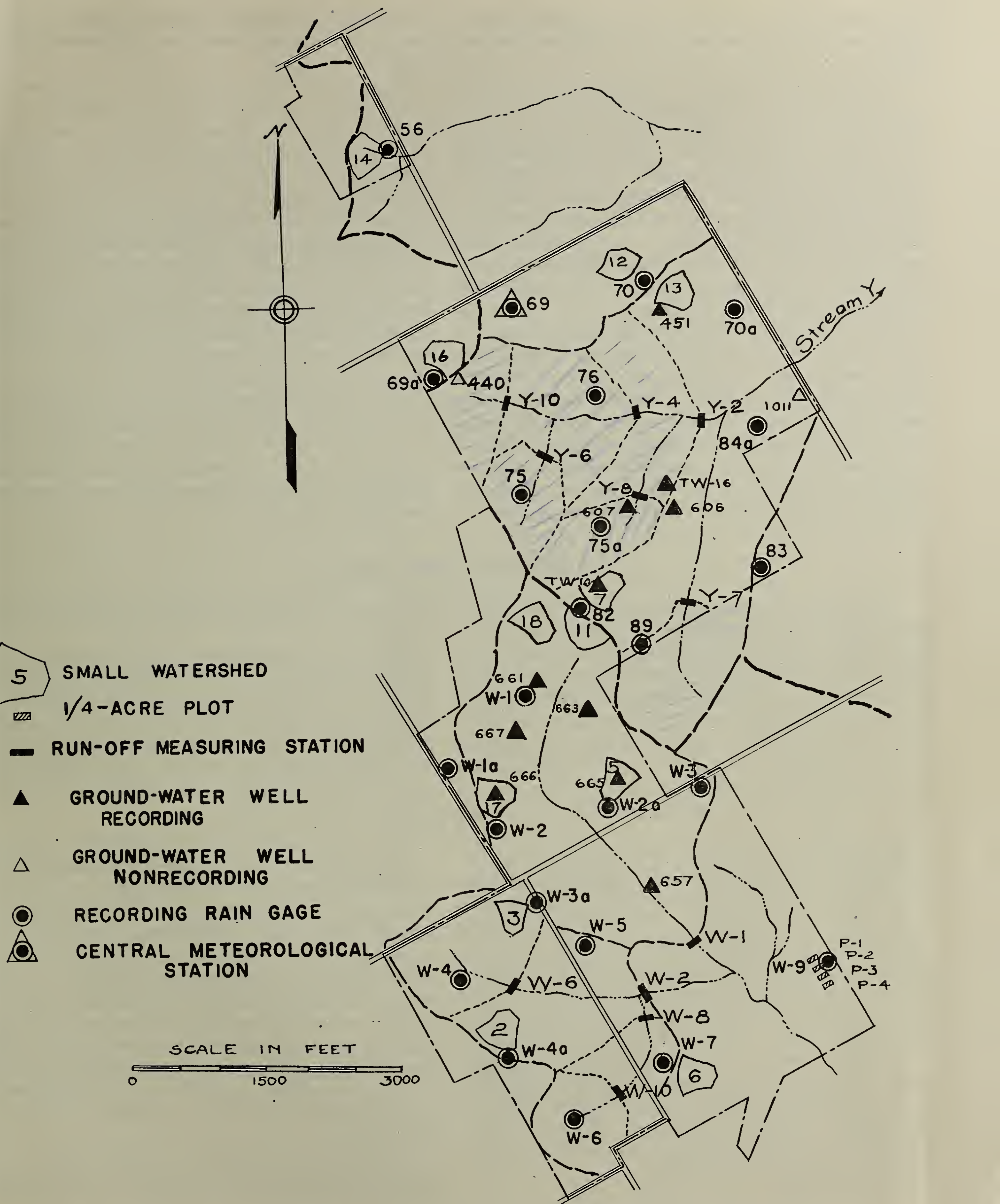

FIGURE 5.—Location of run-off measuring stations, rain gages, and ground-water wells on the Government land.

Riesel and Mart. It covers 6,351 acres, 841 acres of which are on land purchased by the Federal Government.

The relief of the Blacklands is gently rolling to nearly level but is steeper and more broken along the western boundary of the main prairie. The principal streams draining these prairies are the Trinity, Brazos, and Colorado Rivers, all of which have their headwaters outside the Blacklands and flow diagonally across them in a southeasterly direction. Most of the tributary drainage basins are long and narrow. The stream channels are subject to some shifting and are bordered by broad flats that are frequently flooded. All but the larger streams are normally dry in summer.

Except for 530 acres of the government land, all the experimental area lies within the Brushy Creek watershed. Brushy Creek is a tributary of Big Creek which flows into the Brazos River. Brushy Creek is the one main drainageway. It has relatively few short tributaries, which join it at intervals throughout its length.

A broad flat, widest at the junction of the tributaries, extends along Brushy Creek in a position characteristic of a second bottom. It appears too extensive to have been developed by the present stream, but there is no evidence that it was formed in any other way.

The relief of the experimental area, like that of all the Blacklands, is gently rolling to nearly level. Plate 1, *A*, is a view of a part of the area and shows the relief and the general arrangement of the fields. Elevations range from 464 to 592 feet. Sixty-nine percent of the area has a slope of 1 to 3 percent and 80 percent a slope of 1 to 6 percent. These slopes are suitable for cultivation but are subject to accelerated erosion unless cultivation is supplemented by effective conservation practices. Seventeen percent of the area has slopes less than 1 percent and is suitable for cultivation with relatively simple conservation practices. Three percent of the area has slopes greater than 6 percent and should be retired from cultivation.

Within the experimental area are 34 watersheds from which run-off and other hydrologic and land use records are being obtained. The interrelation of the watersheds in Brushy Creek drainage basin and their instrumentation is shown in figure 4 and that on the government land in figure 5.

GEOLOGY AND SOILS[4]

The geologic materials from which the main Blackland prairie developed belong to three groups in the Gulf series of the Cretaceous system, the Austin, the Taylor, and the Navarro (fig. 2). The remainder is developed from the Eagle Ford and other formations. Of the three principal groups the Austin is the oldest and the Navarro the youngest. Each group includes several formations varying in their characteristics. Except in the northeastern part of the main prairie, the Austin consists of a hard chalk containing a small amount of clay and very little sand. The Taylor is dominantly marl varying in carbonate content but also includes strata of sand and chalk. Adkins,[5] in referring to the Taylor, states that in the approximate latitude of Temple the Taylor group consists of the following known beds, in ascending order: (1) Chalk marl, (2) unnamed clay-marl, (3) Durango sand, (4) unnamed clay, (5) Lott and possibly other chalks, (6) unnamed clay, (7) chalks, probably including the Marlin chalk, (8) unnamed clays. The Navarro is the least calcareous of the three groups. It has been divided into three major formations: The Neylandville, the oldest; the Nacatoch; and the Kemp, the youngest. There is considerable variation in the strata of each of these formations; principally, however, they consist of calcareous clay that in many places contains considerable sand.

All the watershed lies on formations of the Taylor group. In this locality these strata dip approximately 80 feet per mile in a direction about south 75° east; consequently, they intersect the surface in irregular bands crossing the area from southwest to northeast. The three general types of rocks, in ascending order, are sandy marl containing some fragmentary sandstone lenses, chalk, and highly calcareous marl.

The sandy marl represents the southern extension of the member known as the Wolfe City sand and is more variable than the other two types of rock. It has the lowest calcium carbonate content, ranging from 5 to 25 percent. This sandy marl outcrops on about one-third of the watershed. The chalk represents the lower part of the Pecan Gap chalk, is rather uniform, and has a calcium carbonate content of 70 to 80 percent. It appears on only a small part of the area, outcropping within a narrow band diagonally across the watershed. The highly calcareous marl has a calcium carbonate content of about 50 percent, is the most uniform, and immediately underlies almost two-thirds of the experimental area.

The soils strongly reflect the character of the geologic material from which they are formed. In the Blackland

[4] For detail on geology see reference in footnote 1.

[5] See reference in footnote 3.

prairie the Austin, the Taylor, and the Navarro groups principally form soils of the Austin, the Houston, and the Wilson and Crockett series, respectively. Within the Taylor group there are sandy members that develop into soils similar to those of the Wilson and Crockett series and more chalky members that develop into soils similar to those of the Austin series.

The Houston soils are the most extensive and valuable soils in the Blacklands. They are deep and, although erosion has been great in much of the area, they remain potentially productive since a considerable loss of soil still leaves a sufficient depth for crop production. The marl from which these soils are formed weathers rapidly; therefore, even in areas where erosion has been severe the soil can be made fairly productive by good land use practices. These practices must be continued if yields are to be maintained. The smoothness of the terrain limits erosion over much of the area primarily to sheet erosion; consequently, the land remains tillable even though less productive.

The Austin soils resemble the Houston soils, but are more friable and generally shallower. The shallower soil development and the more broken and steeper soil surface are attributable to the harder nature of the parent material, the chalk resisting disintegration and erosion to a greater extent than the marl. In cultivated areas erosion has removed much of the dark surface soil and has exposed the light-colored chalky parent material over extensive areas. Deep gullies are not prevalent, since the soils are shallow and the underlying chalk resists cutting.

The soils of the Crockett and Wilson series are primarily on the eastern border of the main prairie. The surface of the Wilson soils is gently undulating to nearly flat and that of the Crockett soils is more rolling. Soils of these series contain quantities of fine sand, the upper layers are dominantly noncalcareous and tend to become very tight and hard on drying. Erosion is confined for the most part to the Crockett soils, although there is serious erosion on some areas of the Wilson soils.

In addition to the soils developed from the parent rock there is a rather extensive although relatively small proportionate area of soils developed from both ancient and recent alluvium. Ancient alluvium as used here refers to depositions made since the uplift of this part of the Gulf Coastal Plain. These soils in general reflect the character of the rock from which they are formed and may exhibit characteristics dissimilar to those of the dominant soils of the region. The soils developed from ancient alluvium generally occupy high upland positions, in many places flats or dissected terraces, and range in their characteristics from soils very similar to those of the Houston and Wilson series to soils closely related to sandy soils of the east Texas timber country.

The seriousness of erosion in that part of the Blackland prairie in the Brazos River watershed is indicated by Geib, who states that 97.7 percent of the cultivated land is eroded, 59.4 percent by sheet erosion alone and 38.3 percent by sheet and gully erosion.[6]

Most of the soils of the experimental watershed belong to the Houston, Wilson, and Crockett series. The soils were grouped according to their characteristics as is shown on pages 13-16 and in legend on the back of the maps in the folio. A description of the soil types mapped on the watershed is given in the Appendix, pages 35-38.

CLIMATE

The mean annual temperature ranges from about 64° F. in the northern part of the main Blackland prairie to about 68° in the southern part. Long, hot summers, and short, relatively mild winters are characteristic of the climate. The summer heat is relieved somewhat by the prevailing southerly winds. Winter temperatures fluctuate much more widely than summer temperatures. Cold waves, generally lasting only a few days, occur periodically during the winter and are sometimes accompanied by freezing temperatures and light snowfall.

Over most of the area the average annual rainfall is from 35 to 40 inches and at the southwestern limit of the main Blackland prairie is about 30 inches. Short storms of very high intensities are common, particularly during the spring and summer months. Storms of longer duration and large amounts of rainfall occur less frequently. Vance and Lowry[7] list 33 major storms for Texas during the 43 years from 1891

[6] See reference in footnote 3.

[7] VANCE, A. M., and LOWRY, ROBERT L., JR. EXCESSIVE RAINFALL IN TEXAS. Tex. State Reclam. Dept. Bul. 25, 149 pp., illus. 1934. See pp. 19-76.

to 1933. In all but 5 of these storms the maximum depth of rainfall was more than 10 inches; in 12 it was more than 15 inches; and in 5, more than 20 inches. Most of these storms covered parts of the Blacklands and some of them centered there.

The general description of the climate for the region applies to the project. United States Weather Bureau records for Waco, Tex., are available for the 49-year period, 1890 to 1938. The average length of the growing season is 248 days. The average date of the last killing frost in the spring is March 12 and of the first in the fall is November 15. The latest recorded date of a killing frost in the spring is April 9 and the earliest in the fall is October 22. The prevailing wind direction is south except during November, December, January, and February when it is north.

The mean annual precipitation is 34.90 inches. Well over one-third of the annual rainfall normally occurs in April, May, and June, and the remainder is fairly well distributed throughout the year as shown in table 1. Rainfall may, however, be poorly distributed in any year.

TABLE 1.—*Monthly, seasonal, and annual temperature and precipitation at Waco, McLennan County, Tex.*[1]

[Elevation, 424 feet]

Month	Temperature			Precipitation		
	Mean [2]	Maximum [3]	Minimum [3]	Mean [2]	Maximum [4]	Minimum [4]
	°F.	°F.	°F.	Inches	Inches	Inches
December	50.1	86	2	2.98	11.76	0.00
January	48.5	90	−1	1.79	6.56	.00
February	51.0	95	−5	2.33	6.19	.00
Winter	49.9	95	−5	7.10	14.98	.85
March	59.2	99	18	2.96	8.38	.00
April	67.4	100	28	4.30	13.01	.20
May	75.1	101	38	4.67	10.51	.08
Spring	67.2	101	18	11.93	29.78	3.48
June	82.9	107	52	3.43	11.55	T
July	86.1	107	61	2.21	8.95	.00
August	85.6	111	54	2.03	9.98	.00
Summer	84.9	111	52	7.67	19.85	.93
September	79.2	102	43	2.76	11.17	T
October	68.3	100	29	2.84	8.90	.00
November	57.8	90	19	2.60	10.36	.00
Fall	68.4	102	19	8.20	20.01	1.72
Year	67.6	111	−5	34.90	60.20	13.39

[1] From U. S. Weather Bureau records.
[2] A uniform 35-year period as taken from Climatological Data, Texas Section, U. S. Weather Bureau.
[3] 62-year record, 1867 to 1938.
[4] 49-year record, 1890 to 1938.

AGRICULTURE

The native vegetation in the Blackland prairies was dominantly tall prairie grasses but included some short grasses and scattered patches of mesquite trees. The admixture of short grasses appears to have been greater in the southern than in the northern part. The flood plains bordering streams were originally wooded, the trees consisting primarily of elm, hackberry, ash, and oak. Some tree and brush growth remains on much of the area immediately adjacent to the larger streams. There are scattered clumps of live oak in the upland in certain sections, also an occasional small wooded area usually on soils closely related to those common to the east Texas timber country.

The earliest settlers on Brushy Creek watershed were ranchers who utilized the land chiefly for grazing purposes, leaving it unbroken and unfenced. It was not until about 1880 that the large holdings began to be sold in small blocks and the sod broken for the production of crops. Each year as the population increased and better markets for farm products developed, more land was broken and placed under cultivation until during World War I the present intensity of cultivation in the area was attained.

The land was brought under cultivation largely by German immigrants. These and their descendants still own and operate much of the land in the watershed, especially in the southern part. These enterprising farmers early recognized the value of the native grasses, and on most farm units controlled by them a small acreage of grassland has been retained unbroken. The grass on these areas is cut for hay once a year and is fed to livestock during the winter months. Other areas generally along drainageways are fenced for pasture. Grazing has resulted in destroying the little bluestem formerly dominant on the well-drained areas of these pastures and it has now been replaced by buffalo grass. Bermuda grass has spread and become the dominant grass in low areas that receive depositions of eroded material and in areas once broken and later retired from cultivation.

Throughout the Blacklands, cotton is the chief crop, corn is second, and oats and sorghum are next. Seventy-nine percent of the experimental area is cultivated (table 2), and over 50 percent of this cultivated land is in cotton. The spread of root rot infection, together with the low price of cotton and the cotton-reduction and soil conservation programs, has contributed in recent years to a decrease in the acreage planted to cotton and a corresponding increase in the acreage of feed crops, such as corn, sorghum, and oats. The oat acreage is most extensive where the land is steepest and the soils relatively shallow.

TABLE 2.—*Land use and crop distribution, 1937*

Cover	Area		
	Size	Ratio to cropped area [1]	Ratio to entire area
	Acres	*Percent*	*Percent*
Cotton	2,850	57	45
Corn	1,310	26	20
Oats	409	8	6
Sorghum, hegari, and maize	313	6	5
Sudan grass	99	2	2
Legumes	52	1	1
Johnson grass and idle land	218		3
Pasture	811		13
Native grass cut for hay	179		3
Miscellaneous	110		2
Total	6,351	100	100

[1] Area cropped 5,033 acres, or 79 percent of the entire area.

Cotton and corn, and, to a large extent, sorghum, are intertilled crops. Thus much of the cultivated land is in a condition most susceptible to erosion. This, together with the relative imperviousness of the soil and the torrential character of the rainfall, makes erosion control a problem that is not easily solved.

Johnson grass, Bermuda grass, and other vegetation furnish erosion protection on abandoned land in a year or two if the land is not severely gullied. Johnson grass has considerable value for hay and pasture, but it is usually considered a serious weed problem in cultivated fields. Bermuda grass is a good pasture grass and unexcelled as an erosion-resisting vegetative cover.

Terracing supported with an adequate system for conducting the run-off water to the stream channel is the most reliable erosion protection for cultivated land. Sodded terrace-outlet channels and pasture strips that are carefully planned have been satisfactory protection for terrace outlets. Strip cropping is used alone and in conjunction with terracing for erosion control. Alone, its effectiveness is limited by the length and degree of slope and by the seasonal change in the crops used. Oats and broadcast sorghums are the most common crops used for strip crops. In certain sections, Hubam clover, alfalfa, and perennial grass strips are used.

Unless the land is terraced, it is generally cultivated parallel to fence lines without regard to the slope. Where the land is terraced, cultivation follows the terrace lines. For the most part present terraces are not built in accordance with recommended specifications, and terrace outlets are generally protected ineffectively if at all. The current practice of building up high beds frequently changes the direction, length, and velocity of overland flow, which may divert considerable surface water out of its natural drainage basin. For this reason the type of cultural practice and the direction of cultivation may influence the hydrologic performance of small watersheds.

Changes in cropping practices to reduce erosion and still provide a livelihood for the agricultural population are possible, but prospects for rapid changes are not favorable. Studies are under way to develop new crops and markets. At the present time, however, no other crops are generally grown that profitably compete with cotton and corn even under present low prices. There is an outstanding need for some adapted fibrous-rooted close-growing crop that will provide effective cover throughout the year and that can be easily established and eradicated, thus making it suitable for use in rotation with tilled crops. Certain grasses and legumes fill these requirements for protection in other sections of the United States.

The high price of land and the small natural supply of water limit the raising of livestock, an otherwise practical revision in the agriculture of the section. The development of artificial ponds for storage of surface run-off is usually possible but sometimes rather expensive. Short-term tenancy is another condition that does not favor livestock farming. In general, the only livestock kept are the work stock and a milk cow or two. Some of the farmers, especially resident-owners, keep a flock of laying hens and they may have a larger number of cows and some young stock. On most farms the only hogs raised are those used for the family meat supply. Grazing can be supplied the year round. Supplemental feeding, however, is required to winter stock satisfactorily.

If erosion-control measures are to be made effective the distribution of precipitation by seasons and the sequence of meteorologic events that affect the amount and intensity of precipitation required to produce run-off must be taken into consideration. Essentially this means that control measures should provide more protection during the winter and spring months than during the remainder of the year. The normally ample supply of soil moisture available for plant growth during the winter and spring makes this part of the year most favorable to successful revegetating operations. Terrace and channel construction can be most satisfactorily carried on in late summer and early fall when the soil is normally drier.

FARMING PRACTICES

Current farming practices in this area do not provide for crop rotation. Generally, cotton is planted almost continuously on the best cottonland and feed crops on the remainder of the cultivated area. Some of the better farmers, however, do not grow cotton on the same area more than two years in succession and corn is seldom followed by corn. Preparation of the land for cotton and corn consists of bedding, which is commonly done in the fall. A common practice is to center furrow and bed (pl. 1, *B*). The beds or ridges are usually about 8 inches high and 36 inches apart. The

height of these ridges is gradually lowered by weathering, and the ridges are almost eliminated during planting. Cotton is planted on the bed and corn on the bed or in the furrow, usually on the bed on the heavier soils and in the furrow on the lighter ones. If cotton or corn follows a drilled crop, the land may be plowed soon after harvest of the drilled crop and bedded later.

The farm implements commonly used in this area are listers for bedding, moldboard and disk plows, cotton and corn planters, cultivators (usually equipped with sweeps), grain drills, and grain and row binders. Most of these are horse-drawn, but some are one- and two-row tractor equipment.

Cotton may follow any of the crops grown in this section. Most commonly it will follow corn, oats, sorghum, or cotton. Preparation of the land for cotton is usually started soon after the previous crop is harvested. Following a corn crop the area for cotton is commonly bedded in October; following oats, in July or August; following sorghum, in August or September; and following cotton, in November. Weed growth is controlled by rebedding until about March 1. The cotton is planted in 36-inch rows, the time of planting ranging from April 1 to May 15. When the plants are from 2 to 4 inches high they are thinned out, one plant being left every 8 to 10 inches. The cottonfields are then cultivated as frequently as necessary to control weeds until about August 15, sometimes as often as eight times per season. The first cotton is usually picked about August 1 and the last in October.

Cotton in this area is attacked by root rot. The disease normally makes its first appearance at some time during the first part of July before any bolls are fully grown. By the latter part of July most of the plants in a field may be affected. The extent of dead cotton varies widely from one field to another and from one year to another. In badly infested areas the dead plants may represent over 75 percent of the stand. Summer rains are said to augment root rot infestation.

Corn in this area usually follows cotton, but it may follow oats fairly satisfactorily. Corn is planted in 36-inch rows and thinned to a spacing of about 36 inches in the row. Some farmers plant two rows to corn and leave one row idle or later plant it to cowpeas. In thinning this corn, the plants are left with closer spacings in the row. When corn is to follow cotton the land is bedded soon after the cotton crop is harvested, usually sometime between October 15 and January 15. Many fields are rebedded just a few weeks before planting corn. Although corn may be planted any time in March and sometimes earlier or later with success, it is normally planted between March 10 and 20. Generally the best corn crops result from relatively early plantings because then the heavy draft of the corn plant on soil moisture occurs when soil moisture is still plentiful.

Corn is usually too large for further cultivation by June. By the middle of August it can be harvested, although the harvesting is frequently delayed until September or October. Most corn is harvested by snapping the ears from the stalks, and the stalks are left standing in the field. Corn is stored without shucking. The cornstalks are cut and left in the field and the land bedded preparatory for the next crop soon after corn is harvested.

Between the last cultivation and the harvest a heavy growth of grass and other weeds usually develops in cornfields. This growth keeps the soil moisture depleted and thus increases the amount of precipitation required to produce run-off. This vegetation further affords protection against erosion by stabilizing the soil and furnishing a protective mantle.

Oats usually follow cotton and, without any seedbed preparation, are drilled in 7-inch rows among the cottonstalks. Oats may be planted any time during October, the date being largely determined by the soil moisture. Fall-planted oats occasionally are severely damaged by extremely cold weather, and, therefore, some oats are planted in the spring, normally about February 1. Spring oats, however, are not common as they usually yield much less than fall oats. Oats generally make considerable fall and early winter growth, giving the land much protection from erosion during the winter months. The rapid early spring growth of oats, causing a heavy draft on soil moisture, tends to reduce run-off during this period. Oats start heading about May 1 and are harvested about June 1. A common practice is to plow the land immediately after harvesting if moisture conditions permit.

The most common sorghums in this area are hegari, adapted forage sorghums, and Sudan grass. These crops may be planted with an ordinary grain drill or planted in rows and cultivated as are cotton and corn. Depending on the use to be made of the crop, the planting date ranges from April 1 to June 1. These crops may be either cut for hay or cut with the row binder for forage. Hegari and other grain sorghums may be harvested for the grain only and the stalks pastured later during the season. Sudan grass is usually used as supplemental pasture, but it is frequently planted in rows and cultivated even for this purpose. The harvesting of all these crops is practically complete by September 1. Soon after September 1 the land normally is plowed or bedded in preparation for the succeeding crop.

Permanent pastures in this area are either Bermuda grass or buffalo grass. Buffalo grass pastures result where upland native grass areas are grazed for a number

A, Typical terrain in the Brushy Creek watershed. *B*, Bedding a field before planting cotton. This field had previously been center-furrowed following the harvest of the corn crop.

A, Cracks in the face of a gully in Houston black clay. Note the slaked soil that has caved from the face of the gully as it dried. *B*, Another view of the gully in *A*, showing the process by which destructive erosion occurs once a gully has been formed. The columns of soil in the bottom of the gully broke away from its face when rain entered the cracks and loosened the material attaching the columns. The next rain causing run-off will carry the material away, together with material from other columns caving at the time of the rain. *C*, View of the gully in *A* and *B* at a later date following approximately 3 inches of rain that wet the surface soil and closed the cracks in the surface but not those in the subsurface. The photograph was taken the day following the rain. *D*, Dry-weather cracks in Houston black clay. *E*, Depressions in Houston black clay on the tops of hills in virgin grassland. *F*, Virgin prairie grass on Houston-Hunt clay. Note the uneven surface. The ridges are Houston clay and the depressions Hunt clay.

of years. Much of the pasture is along drainage channels subject to overflow and may contain much brush and weeds. Mowing of pastures at least once each year is recommended as a means of controlling weed growth and mesquite sprouts wherever practicable. Pastures have a fairly good carrying capacity in spring and early summer and occasionally for a longer period, when moisture is available for grass growth. Since the establishment of Bermuda grass or buffalo grass pastures requires much effort, areas in pasture usually remain in pasture for many years.

A number of small areas of virgin grass have been retained for the production of hay. Little bluestem is the dominant grass in most of these areas, although, where poorly managed, weeds and less desirable grasses may become dominant. The grass is usually cut once during the season, generally about July 1. Some grazing may be obtained during winter months, but heavy grazing at any time is very damaging to the stand of the better varieties of hay grasses.

THE CONSERVATION SURVEY

METHODS AND DEFINITIONS

A conservation survey of the greater part of the Blacklands Experimental Watershed was made in the spring of 1937 and of the remaining area in the fall of 1938. Aerial photographs on a scale of 1 inch equals 423 feet were used in the field mapping. Soil type, soil depth, type and extent of gullying, slope, and land use were mapped. Soil, erosion, and slope are indicated on the map in the folio by a composite symbol. The extent of the area to which the symbol applies is defined by green boundary lines. Land use is shown independently. The features of the conservation survey were superimposed on a topographic base map having a contour interval of 2 feet and a scale of 1 inch equals 400 feet. Watershed boundaries and instrumentation are also shown. This map, which is in the folio, consists of 21 quadrangle sheets. The area covered by each quadrangle is shown on the index map in the folio.

Only two land use classes are shown on the map—cultivated land and land in permanent grass. Included with the cultivated land is a small acreage of idle land. The land in permanent grass includes pastures and native grass meadows cut for hay once annually. Areas in meadow cover about one-fifth of the grassland, and all are in the lower half of the watershed. Areas having sufficient brush and tree growth to be classed as brushy pasture, and also those that have been seriously overgrazed, resulting in the exposure of much bare soil and in weed growth, were included in the grassland. The limits, in percent, of the slope classes mapped on this area are: A, less than 1; B, 1–3; BB, 3–6; C, 6–8; D, 8 and over.

Degree of erosion was estimated by comparing the present depth of the soil profiles with the depth of comparable virgin profiles of the same soil type. If virgin profiles could not be found the best information available was used. Gully erosion was classified according to the type and frequency of gullies. Two types were mapped in the watershed—shallow gullies, which can be crossed by tillage implements but are not obliterated by normal tillage operations, and deep gullies, which cannot be crossed by tillage implements and which may have penetrated into a compact C horizon. The deep gullies are distinguished from the shallow gullies by circles around the gully-erosion symbols. The various types and degrees of erosion and the symbols used to designate them on the map are as follows:

Sheet erosion:

- 2 Less than 25 percent of the A horizon removed.
- 3 25 to 75 percent of the A horizon removed. (On soil group 2, 25 to 50 percent of the A horizon removed.)
- 33 50 to 75 percent of the A horizon removed. (Used only on soil group 2.)
- 4 75 percent or more of the A horizon removed, or all of the A horizon and part of the B horizon.
- 5 Most or all of B horizon removed, parent material may be exposed or removed.

Gully erosion:

Shallow	*Deep*	
7	⑦	Occasional gullies: Less than 3 per acre.
8	⑧	Frequent gullies: More than 3 per acre but less than 75 percent of the area.
9	⑨	Very frequent gullies: 75 percent or more of the area delineated included within the gullies.

Recent deposits:

+

SOIL GROUPS

Twenty-three soil types and phases were recognized on the experimental watershed. These can be segregated in four groups having somewhat similar morphological characteristics. The relative extent of these soil groups in Brushy Creek watershed is as follows:

Proportion of Brushy Creek watershed in soil group—	*Percent*
1. Prairie soils, granular structure, alkaline throughout:	
a. Normal profile	66. 0
b. Shallow to parent material	6. 4
2. Prairie soils, moderately calcareous substrata:	
a. Dense on drying	10. 3
b. Moderately friable	7. 9
3. Colluvial soils	5. 3
4. Alluvial soils	4. 1

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For all the soil types in a particular group of prairie soils a given degree of sheet erosion could also represent a certain approximate depth of soil remaining on the area. Table 3 gives the approximate range in depth and the assumed average depth that corresponds to each degree of sheet erosion on the prairie soils. For the soils of group 1 the depth to parent material is given, and for the soils of group 2 the depth to the B horizon. No depth classes were determined for the colluvial and alluvial soils. Obviously no great refinement could be obtained in these relationships, and the average depth was assumed to be the average of the limits of the range in depth except where a knowledge of conditions indicated that some modification would add to the accuracy of the result.

TABLE 3.—*Soil depth in soil groups 1 and 2*[1] *corresponding to each class of sheet erosion*

Erosion class	Depth to— Parent material in soil group— 1a: Range	1a: Assumed average	1b: Range	1b: Assumed average	B horizon in soil group 2: Range	B horizon in soil group 2: Assumed average
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
2	60 or more	60	36 or more	48	12 or more	14
3	36–60	48	12–36	24	8–12	10
33					4–8	6
4	12–36	24	0–12	6	0–4	2
5	0–12	6	(2)	0		

[1] Depth limits were not defined for soil groups 3 and 4.
[2] Exposed rock.

GROUP 1. PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT

a. Normal profile

Houston black clay, Houston black clay gravelly phase, Houston-Hunt clay, and Houston black clay saline phase have been included in group 1a. Soils of this group are the most extensive, occurring on about two-thirds of the experimental area, and they are the most productive.

The parent materials of this group of soils are highly calcareous marls. The marl weathers rapidly, giving rise to deep soils with little profile development. Changes in physical and chemical properties grade from the surface to the parent material, there being no evidence of the development of a B horizon. Large cracks develop as these soils dry. Largely because of these cracks and the granular structure, quantities of water can be taken up quickly. When wetted the soil granules swell, the cracks close, the surface soil becomes exceedingly sticky, and the soil mass becomes tight, plastic, and practically impermeable (pl. 2).

The Houston black clay is the most extensive and productive of the soils in this group. The Houston black clay gravelly phase occurs on only a small area and is very similar to the Houston black clay except that a considerable quantity of rounded gravel is present in the surface layers. These soil types are of a granular structure and calcareous throughout the profile. The Houston-Hunt clay in many respects is similar to the Houston black clay. It is an intimate mixture of two soils of different color in parallel strips approximately normal to the land contours. In cultivated fields the land surface appears as alternate light and dark strips. The light areas are calcareous throughout the profile and the dark areas noncalcareous at the surface but calcareous at depths below 2 or 3 feet. The parent material of this soil is a marl that is less calcareous and contains more sand than the parent-material marl of the Houston black clay. The Houston black clay saline phase is Houston black clay in which there is a toxic concentration of salts. It occurs on only a few small areas and its productiveness is low.

The relief is gently rolling. Slopes range from 1 to 6 percent, but only a small area has slopes greater than 3 percent. The surface drainage is good although there are few well defined water courses, but the internal drainage is poor because of the impermeable condition of the soil and substrata when wet. Erosion is rather severe in spite of the gentle slopes.

The native vegetation was predominantly prairie grasses consisting largely in order of dominance[7] of little bluestem (*Andropogon scoparius*), Texas needlegrass (*Stipa leucotricha*), big bluestem (*A. furcatus*), side-oats grama (*Bouteloua curtipendula*) and Indian grass (*Sorghastrum nutans*). Native vegetation also included a few scattered mesquite trees. Most of the acreage of these soils is cultivated. The crops commonly grown are cotton, corn, sorghum, and oats.

b. Shallow to parent material

The soils in group 1b resemble those in group 1a except that they are shallower and somewhat more friable. Included in this group are Houston black clay shallow phase, Houston black clay over chalk, Austin clay shallow phase, and chalk outcrop. The extent of the soils of this group is not great and they occur on about 6 percent of the experimental area. All of these soils are of a granular structure and calcareous throughout the profile. The parent materials from which these soils have developed are highly calcareous marl and chalk.

The natural vegetation was predominantly meadow grasses and because of the less productive shallower soil, a smaller percentage of these soils has been cultivated.

[7] WOLFF, SIMON, E. BLACKLAND PRAIRIE MEADOW. U. S. Soil Conservation Serv. TEC-57-37, 4 pp., 1937. [Mimeographed.]

The areas that have been cultivated are more seriously damaged by erosion than those in group 1a, partly because of the shallower soil development and partly because these soils generally occur on steeper slopes. The crops commonly grown are cotton, corn, oats, and sorghum. The soils of this group are better adapted for the production of oats than are those of group 1a. The productiveness of these soils varies widely, depending on depth, soil type, climatic conditions, and the crop grown.

GROUP 2. PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA

a. Dense on drying

The soils in group 2a have a moderately calcareous substratum and become dense on drying. This group is made up of Wilson soils and occurs largely on the broad flat along Brushy Creek. Three types were mapped: Wilson clay, clay loam, and fine sandy loam. The chief factor contributing to the development of the different types is the degree of sandiness of the parent material from which they were derived. This parent material consists of a marl containing variable quantities of fine sand and less calcium carbonate than the parent material of the Houston soils. It is similar to the parent materials from which the Houston-Hunt clay and the soils of the Crockett series were evolved.

In general the profile has about 15 inches of comparatively dense, dark-gray surface soil, the texture depending on the type. The subsoil consists of a lighter gray, somewhat mottled, dense clay, grading at depths of from 4 to 6 feet to a calcareous sandy clay containing numerous calcium carbonate concretions and in many places numerous fine crystals of calcium sulphate. Rounded quartzite pebbles occur here and there throughout the profile.

Owing to the nearly flat topography and the dense solum and substratum, both surface and internal drainage are slow. Weathering has taken place to depths as great as 10 to 12 feet, as evidenced by the presence of soluble substances from the overlying material. Erosion of these soils does not present a serious problem. A small amount of wind erosion sometimes occurs in cultivated fields of the fine sandy loam.

Grass was the predominant native vegetation. It was interspersed with scattered patches of mesquite, a few post oaks, and water elms along the small drainageways.

The Wilson soils, especially the clay and clay loam, are highly productive and their entire area is cultivated, except a small acreage adjacent to drainageways where in most seasons there is a danger of floods and soil moisture conditions delay planting until late. They are especially adapted to the production of cotton, corn, and sorghum, and are utilized primarily for the production of these crops. Owing to their topographic position and drainage characteristics they are less suited to the production of oats, although some oats are grown.

In addition to the acreage along Brushy Creek where these soils are associated with Houston black clay, Catalpa clay, and Houston-Hunt clay, there are a few isolated areas in small depressions on the tops of ridges where water accumulates. Here the Wilson soils are associated with the soils of the Crockett series.

In this area the Wilson soils are somewhat more friable, and a good tilth is produced more easily than is characteristic of these soils where they occur more extensively. This is probably due to the fact that run-off water from higher lying calcareous soils frequently spreads out over these flats and deposits calcareous material and other calcium in the form of exchange ions from the dissolved calcium in the run-off waters.

b. Moderately friable

The soils of group 2b have moderately calcareous substrata and are moderately friable. This group is made up of Crockett soils and occupies about 8 percent of the watershed along the ridge top and slopes west of the drainageway in the northern part of the watershed. Like all soils in this area, the controlling factor in determining the characteristics of these soils is the nature of the geologic material from which they have been derived. The parent material of the Crockett soils is a sandy marl containing approximately 20 percent calcium carbonate. The resulting soils are characterized by a sandy surface over a rather dense, brittle, sandy clay subsoil that grades at a depth of about 3 feet to a sandy marl. In many places this calcareous material is extended upward to a foot or less of the surface. Rounded quartzite pebbles occur here and there throughout the profile.

Two types in the Crockett series were recognized, the clay loam and the fine sandy loam. These are intimately associated and are distributed over the area. Within the areas mapped as Crockett soils are a number of small isolated areas of Wilson soils. The Crockett soils were developed from similar parent material but under better surface drainage than the Wilson soils. In areas dominantly of Crockett soils, Wilson soils occur in small depressions or flat areas on the tops of ridges where water has a tendency to accumulate. A few isolated areas of the Crockett soils occur with the Wilson soils on the broad flat along Brushy Creek. The Crockett soils are bordered primarily by Houston-Hunt clay.

The gently rolling surface of the Crockett soils, which

favors rapid surface drainage, and the dense nature of the subsoil, which greatly impedes percolation, make these soils highly erodible. Erosion has been more damaging to these soils than to any other soil in the watershed, and unless it is controlled all but the more level areas will necessarily be removed from cultivation in the near future because their productivity will be reduced below the limits of profitable operation.

Native vegetation consisted largely of native grasses and of mesquite and some post oak trees. All but a very small part of this land is now under cultivation, the leading crops being cotton, corn, and sorghums. It is fairly well adapted to the production of these crops, but the yields are much lower than on the heavier textured soils.

Weeds and Johnson grass infest these soils. Because of the low productivity of these soils, the quality of farm work on them is poorer than on the more productive types, and much of the area is overrun with weeds and Johnson grass. Their characteristics indicate that these soils would respond readily to the addition of organic matter and to the use of commercial fertilizers.

GROUP 3. COLLUVIAL SOILS

Group 3 is made up of the six colluvial phases mapped. The colluvial phases of Houston-Hunt clay, Crockett clay loam, and Crockett fine sandy loam generally occupy positions skirting the base of slopes occupied by the corresponding residual soils. The colluvial phases of Wilson clay, Wilson clay loam, and Wilson fine sandy loam constitute areas of these types which have received deposition material from associated upland soils. The textural class assigned corresponds to the texture of the surface 6 to 8 inches. These soils are generally more productive than the corresponding residual soils.

Probably there has been more colluvial deposition on Houston black clay than on the soils from which a colluvial phase was separated. A colluvial phase of Houston black clay was not separated because of the difficulty in determining the extent of the deposition. There is evidence that considerable soil eroded from the slopes has been deposited on the area at the base of the slopes in virtually all the acreage of this soil type that is under cultivation. As erosion has not generally progressed to a depth where the lighter colored lower horizons are being removed, areas on which there has been colluvial deposition to all appearances are very similar to areas of uneroded Houston black clay.

GROUP 4. ALLUVIAL SOILS

Group 4 is made up of a small acreage of alluvial soil. Four types have been mapped: The Trinity clay, Catalpa clay, Kaufman clay, and Kaufman fine sandy loam. These soils occur in narrow strips adjacent to Brushy Creek drainageway, extending short distances up the larger subdrainage channels. They are subject to overflow periodically and are of little agricultural importance, for the most part being utilized as pasture. The greater part of these areas supports some trees, primarily water elm, hackberry, and water oak, and brush, such as buckbrush and greenbrier.

WATERSHED CHARACTERISTICS

Throughout the experimental area each watershed bears the same designation as the station for measuring run-off at the outlet of the watershed. As may be seen from the map (fig. 4), stations A, C, D, G, and J, are on Brushy Creek, J being farthest downstream and measuring run-off from all other Brushy Creek watersheds. The 306-acre watershed W, made up of W1 and W2, is on Government land outside the Brushy Creek watershed. All the Y stations and station Z are on tributaries of Brushy Creek. All but four of the 3-acre watersheds on which the intensive experimental work will be conducted are included in watersheds Y and W. For each watershed the size, length of principal drainageway, slope, and land use in 1939 are given in table 4.

The extent and average depth of each soil type on the watersheds above the stations on Brushy Creek are given in table 5 and that on watersheds above stations on the tributaries and on Government land are given in table 6. The average soil depth was computed from the assumed average depth of each class of sheet erosion (table 3, p. 14) weighted by its area. The extent of erosion in the principal watersheds is given in table 7.

Table 4.—*Watershed characteristics*

Watershed [1]	Area	Length of principal drainageway	Slope: Area in slope range of— Less than 1 percent	1–3 percent	3–6 percent	6 percent and over	Average slope [2]	Land use in 1939: Cultivated land	Permanent grass	Roads	Farmsteads
	Acres	Feet	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
A	42.0	1,440	32	66	2	0	1.57	83.8	16.2	0	0
C	579	7,760	14	76	10	0	2.04	80.7	14.4	3.6	1.3
D	1,110	11,760	15	72	13	0	2.10	84.4	11.0	3.2	1.4
G	4,380	25,680	19	68	12	1	2.06	81.7	14.4	2.5	1.4
J	5,860	35,800	17	69	11	3	2.14	80.6	15.7	2.3	1.4
Z	310	4,000	1	85	14	0	2.34	61.0	35.1	2.2	1.7
Y	309	5,040	3	79	18	0	2.41	79.8	18.5	1.2	.5
Y2	132	3,280	6	67	27	0	2.57	92.0	6.9	1.1	0
Y4	79.9	2,760	3	61	36	0	2.86	90.1	9.0	.9	0
Y6	20.9	1,380	10	35	55	0	3.21	99.1	0	.9	0
Y7	40.0	1,970	9	91	0	0	1.87	100	0	0	0
Y8	20.8	1,640	22	67	11	0	2.24	97.5	0	2.5	0
Y10	21.0	1,040	0	85	15	0	1.88	97.5	0	2.5	0
W1 and W2	306	5,400	8	74	18	0	2.33	77.0	18.3	3.5	1.2
W1	176	5,400	11	75	14	0	2.19	86.5	9.3	2.6	1.6
W2	130	3,100	5	74	21	0	2.45	63.9	30.5	4.9	.7
W6	42.3	1,460	0	99	1	0	2.03	75.1	17.7	7.2	0
W8	40.4	2,140	15	65	20	0	2.28	79.6	16.1	3.1	1.2
W10	19.7	1,060	27	72	1	0	2.07	100	0	0	0
2	2.70	400	0	100	0	0	1.91	100	0	0	0
3	3.09	450	0	100	0	0	1.91	100	0	0	0
5	3.09	450	0	48	52	0	3.27	100	0	0	0
6	3.04	410	0	38	62	0	3.18	100	0	0	0
7	3.15	470	11	89	0	0	1.67	100	0	0	0
11	3.23	400	75	25	0	0	.94	100	0	0	0
12	2.97	380	0	22	78	0	3.81	0	100	0	0
13	3.19	430	0	77	23	0	3.07	100	0	0	0
14	3.02	375	0	100	0	0	1.55	100	0	0	0
16	3.17	440	0	100	0	0	2.58	100	0	0	0
17	2.99	380	0	100	0	0	1.83	100	0	0	0
18	3.04	460	72	28	0	0	1.14	100	0	0	0
P1	.243	168	0	100	0	0	2.82	100	0	0	0
P2	.243	168	0	100	0	0	2.98	100	0	0	0
P3	.243	168	0	100	0	0	2.98	100	0	0	0
P4	.243	168	0	100	0	0	2.98	100	0	0	0

[1] Run-off measuring stations at the outlet of the watersheds have the same designations.
[2] The average slope for areas of less than 25 acres was determined by the contour-length method. The average slope for larger areas was computed from the average slope of each slope class weighted by its area.

Table 5.—*Soil types and average depth [1] of soil in watersheds A, C, D, G, and J*

Soil group and type	A: Area	A: Average depth	C: Area	C: Average depth	D: Area	D: Average depth	G: Area	G: Average depth	J: Area	J: Average depth
1. Prairie soils, granular structure, alkaline throughout:	Percent	Inches	Percent	Inches	Percent	Inches	Percent	Inches	Percent	Inches
a. Normal profile:										
1. Houston black clay	0		0.8	51	2.4	53	37.7	58	48.0	59
2. Houston black clay, gravelly phase	.2	48	[2].1	48	[2].1	48	[2].1	57	[2].1	59
3. Houston-Hunt clay	40.6	43	44.6	55	44.3	49	23.2	49	17.8	50
4. Houston black clay, saline phase	0		0		0		[2].1	60	[2].1	60
Total	40.8		45.5		46.8		61.1		66.0	
b. Shallow to parent material:										
5. Houston black clay, shallow phase	0		0		0		2.2	46	4.2	44
6. Houston black clay, over chalk	0		0		0		2.7	28	1.9	28
7. Austin clay, shallow phase	0		0		0		.3	6	.2	6
8. Chalk outcrop	0		0		0		.1	0	[2].1	0
Total	0		0		0		5.3		6.4	
2. Prairie soils, moderately calcareous substrata:										
a. Dense:										
9. Wilson clay	0		2.3	12	4.3	14	5.3	13	5.0	13
10. Wilson clay loam	2.7	14	1.3	14	1.8	13	5.2	12	3.9	12
11. Wilson fine sandy loam	0		2.4	5	1.8	9	1.8	9	1.4	9
Total	2.7		6.0		7.9		12.3		10.3	
b. Moderately friable:										
12. Crockett clay loam	17.3	12	9.5	6	11.7	5	6.5	6	4.8	6
13. Crockett fine sandy loam	22.9	5	17.4	7	13.2	7	4.2	7	3.1	7
Total	40.2		26.9		24.9		10.7		7.9	
3. Colluvial soils:										
14. Houston-Hunt clay, colluvial phase	0		0		0		.5		.4	
15. Wilson clay, colluvial phase	11.3		7.8		7.9		3.5		2.6	
16. Wilson clay loam, colluvial phase	5.0		7.7		6.4		2.1		1.5	
17. Wilson fine sandy loam, colluvial phase	0		.4		.8		.5		.3	
18. Crockett clay loam, colluvial phase	0		0		.2		[2].1		.1	
19. Crockett fine sandy loam, colluvial phase	0		3.7		2.0		.6		.4	
Total	16.3		19.6		17.3		7.3		5.3	
4. Alluvial soils:										
20. Trinity clay	0		0		0		.8		.9	
21. Catalpa clay	0		1.3		1.8		2.1		2.9	
22. Kaufman clay	0		.7		.8		.3		.2	
23. Kaufman fine sandy loam	0		0		.5		.1		.1	
Total	0		2.0		3.1		3.3		4.1	

[1] Depth to parent material in soil group 1 and to B horizon in soil group 2. Depth classifications not made for colluvial and alluvial soils.
[2] Less than 0.1 percent.

TABLE 6.—*Soil types and average depth of soil in watersheds Z, Y, and W, and the watersheds lying within Y and W*

Watershed	Houston black clay		Houston black clay, gravelly phase		Houston-Hunt clay		Houston black clay, shallow phase		Houston black clay, shallow phase over chalk		Austin clay, shallow phase		Trinity clay
	Area	Average depth	Area	Average depth	Area	Average depth	Area	Average depth	Area	Average depth	Area	Average depth	Area
	Percent	*Inches*	*Percent*	*Inches*	*Percent*	*Inches*	*Percent*	*Inches*	*Percent*	*Inches*	*Percent*	*Inches*	*Percent*
Z	67.9	60	0	----------	0	----------	30.8	47	0	----------	0	----------	1.3
Y	65.7	57	0	----------	0	----------	15.2	47	17.5	27	1.1	6	.5
Y2	75.2	58	0	----------	0	----------	0	----------	22.5	26	1.8	6	.5
Y4	73.9	58	0	----------	0	----------	0	----------	23.8	26	2.3	6	0
Y6	34.6	60	0	----------	0	----------	0	----------	58.1	26	7.3	6	0
Y7	84.5	60	0	----------	0	----------	15.5	48	0	----------	0	----------	0
Y8	93.0	57	0	----------	0	----------	0	----------	7.0	48	0	----------	0
Y10	93.9	59	0	----------	0	----------	0	----------	4.7	24	1.4	6	0
W1 and W2	68.0	55	6.8	57	0	----------	24.9	47	0	----------	0	----------	.3
W1	66.4	55	0	----------	0	----------	33.4	47	0	----------	0	----------	.2
W2	69.8	50	16.0	57	0	----------	13.6	46	0	----------	0	----------	.6
W6	98.7	60	0	----------	0	----------	1.3	48	0	----------	0	----------	0
W8	55.8	58	24.2	56	0	----------	20.0	44	0	----------	0	----------	0
W10	61.0	51	39.0	57	0	----------	0	----------	0	----------	0	----------	0
2	95.8	60	4.2	60	0	----------	0	----------	0	----------	0	----------	0
3	100	60	0	----------	0	----------	0	----------	0	----------	0	----------	0
5	7.8	60	0	----------	0	----------	92.2	36	0	----------	0	----------	0
6	0	----------	0	----------	0	----------	100	24	0	----------	0	----------	0
7	100	60	0	----------	0	----------	0	----------	0	----------	0	----------	0
11	100	60	0	----------	0	----------	0	----------	0	----------	0	----------	0
12	100	59	0	----------	0	----------	0	----------	0	----------	0	----------	0
13	25.5	60	0	----------	0	----------	0	----------	74.5	24	0	----------	0
14	5.1	60	0	----------	94.9	53	0	----------	0	----------	0	----------	0
16	100	60	0	----------	0	----------	0	----------	0	----------	0	----------	0
17	70.4	60	0	----------	0	----------	29.6	24	0	----------	0	----------	0
18	100	60	0	----------	0	----------	0	----------	0	----------	0	----------	0
P1	100	60	0	----------	0	----------	0	----------	0	----------	0	----------	0
P2	100	60	0	----------	0	----------	0	----------	0	----------	0	----------	0
P3	100	60	0	----------	0	----------	0	----------	0	----------	0	----------	0
P4	100	60	0	----------	0	----------	0	----------	0	----------	0	----------	0

TABLE 7.—*Percentage of each large watershed in each erosion class*

Erosion class[1]	Watershed							
	A	C	D	G	J	Y	W1 and W2	Z
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
+	16.3	21.7	20.6	10.5	9.4	0.5	0.4	1.4
2	15.3	17.4	18.1	31.0	31.0	22.2	41.1	31.4
3	44.8	46.5	45.6	27.8	22.3	18.0	4.5	1.6
4	23.6	7.0	6.7	2.5	2.1	1.1	0	.2
27	0	0	0	13.8	17.7	53.8	53.6	65.4
37	0	3.0	3.0	4.4	3.2	0	.4	0
47	0	1.1	.6	.3	.2	0	0	0
28	0	0	0	.1	.1	0	0	0
38	0	0	0	1.2	.9	3.4	0	0
48	0	0	.4	.5	.3	0	0	0
2⑦	0	0	0	5.1	10.7	1.0	0	0
3⑦	0	1.6	3.0	1.2	.9	0	0	0
4⑦	0	1.3	1.5	.5	.3	0	0	0
2⑧	0	0	0	.3	.2	0	0	0
3⑧	0	0	0	.3	.2	0	0	0
4⑧	0	.4	.2	(2)	.1	0	0	0
9	0	0	.3	.4	.3	0	0	0
5	0	0	0	(2)	.1	0	0	0

[1] For explanation of erosion symbols see p. 13.
[2] Less than 0.1 percent.

On the 21 quadrangle sheets in the folio are shown culture, topography, drainage, soil type, slope class, soil depth, erosion, and land use. Contour lines at 2-foot vertical intervals show the shape and slope of the land surface. The degree of erosion, slope class, and soil type are indicated by symbols in delineated areas. Land use shows only the two major classes represented in the area, cultivated land and land in permanent grass.

Each delineated area having a given symbol represents an area that has the given kind and degree of erosion (and its corresponding soil depth), lies within the given slope range, and has the given soil type. In the symbol 37B5, for example, 3 indicates that erosion has removed 25 to 75 percent of the topsoil (and that the soil is 12 to 36 inches deep); 7, occasional gullies; B, slope 1 to 3 percent; 5, Houston black clay, shallow phase. The extent of each of the land separations mapped in watersheds A, C, D, G, and J is shown in table 8, and in the watersheds Z, Y, and W in table 9.

The topography and soil of the small 3-acre watersheds are shown to a larger scale and in greater detail on figures 6 to 18 than on the quadrangle sheets.

Table 8.—*Percentage of watersheds A, C, D, G, and J in each land separation*

Map symbol	Watershed				
	A	C	D	G	J
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
2A1	0	0.395	0.661	4.06	5.91
27A1	0	0	0	.007	.005
2⑦A1	0	0	0	1.96	1.58
3A2	.243	.017	.009	.002	.002
2A3	0	3.30	2.26	.645	.474
3A3	21.9	1.64	.887	.229	.168
4A3	1.61	.109	.059	.015	.011
2A5	0	0	0	.021	.053
3A6	0	0	0	.040	.029
2A9	0	0	2.80	3.14	2.57
27A9	0	0	0	.332	.244
2⑦A9	0	0	0	.056	.041
9A9	0	0	0	.104	.076
2A10	0	0	.131	2.05	1.53
27A10	0	0	0	.058	.042
3A10	0	.150	.275	.295	.217
33A10	0	0	0	.110	.081
37A10	0	0	0	.287	.211
38A10	0	0	0	.103	.076
3⑧A10	0	0	0	.046	.034
2A11	0	0	0	.037	.027
3A11	0	0	.122	.367	.269
33A11	0	0	.092	.112	.082
37A11	0	0	0	.043	.032
38A11	0	0	0	.082	.060
2A12	0	.102	.055	.014	.010
3A12	1.07	.515	.279	.072	.053
33A12	0	.048	.026	.023	.017
337A12	0	0	0	.816	.600
4A12	0	.134	.141	.037	.027
2A13	0	.121	.065	.017	.012
3A13	0	.616	.320	.148	.109
33A13	0	1.93	1.65	.426	.313
37A13	0	0	0	.049	.036
337A13	0	0	0	.074	.054
4A13	0	.073	.089	.023	.017
+A15	4.21	1.63	2.13	1.40	1.03
+A16	3.04	2.87	2.85	.849	.634
+A17	0	0	.312	.281	.206
+A20	0	0	0	.017	.012
+A21	0	0	0	0	.187
+A23	0	.480	2.63	.099	.073
2B1	0	.231	.647	9.37	7.72
27B1	0	0	0	11.4	16.0
2⑦B1	0	0	0	2.93	9.02
28B1	0	0	0	.147	.108
2⑧B1	0	0	0	.253	.186
3B1	0	0	1.05	3.05	3.01
37B1	0	0	0	.208	.153
3⑦B1	0	0	0	.325	.258
38B1	0	0	0	.139	.102
3⑧B1	0	0	0	.124	.091
4B1	0	.193	.105	.053	.051
2B2	0	0	0	.021	.016
2B3	1.54	8.21	7.16	4.06	3.02
27B3	0	0	0	2.04	1.50
3B3	7.72	19.0	19.0	9.56	7.13
33B3	0	0	0	.185	.136
37B3	0	1.23	2.21	.689	.506
3⑦B3	0	0.425	1.03	0.407	0.299
38B3	0	0	0	.062	.046
4B3	7.33	1.33	.834	.264	.194
4⑦B3	0	0	0	.086	.063
2B4	0	0	0	.012	.135
2B5	0	0	0	1.49	2.33
3B5	0	0	0	.149	.214
4B5	0	0	0	0	.106
2B6	0	0	0	.174	.128
3B6	0	0	0	.784	.576
38B6	0	0	0	.069	.051
4B6	0	0	0	1.22	.089
2B9	0	1.73	1.19	.954	1.63
27B9	0	0	0	.019	.014
3B9	0	.291	.157	.132	.097
33B9	0	0	0	.055	.041
4B9	0	.254	.138	.036	.026
9B9	0	0	0	.184	.135
2B10	2.58	1.15	1.16	1.19	.962
3B10	0	.031	.249	.499	.453
33B10	0	0	0	.122	.115
37B10	0	0	0	.027	.020
33⑧B10	0	0	0	.088	.064
47B10	0	0	0	.049	.036
2B11	0	.236	.447	.312	.235
2⑧B11	0	0	0	.006	.004
3B11	0	.740	.400	.168	.123
33B11	0	1.05	.568	.338	.249
37B11	0	0	0	.107	.079
337B11	0	0	0	.055	.041
338B11	0	0	0	.104	.076
33⑧B11	0	0	0	.026	.019
4B11	0	.243	.131	.063	.046
2B12	6.99	.946	.752	.340	.250
3B12	7.79	1.56	1.05	1.18	.869
33B12	0	1.58	3.62	1.73	1.28
337B12	0	0	0	.318	.233
33⑦B12	0	.728	.614	.159	.117
4B12	0	1.99	2.39	.826	.612
47B12	0	.134	.072	.106	.078
4⑦B12	0	1.17	1.07	.277	.203
48B12	0	0	.133	.127	.093
⑨B12	0	0	.263	.068	.050
2B13	4.21	.573	.366	.127	.093
3B13	.973	4.43	3.39	.970	.713
33B13	3.14	5.43	4.22	1.51	1.11
3⑦B13	0	.304	.164	.043	.031
337B13	0	1.81	.978	.253	.185
4B13	14.7	1.53	1.19	.410	.301
47B13	0	.958	.518	.134	.098
4⑦B13	0	.139	.075	.019	.014
+B14	0	0	0	.495	.364
+B15	7.06	6.21	5.69	2.12	1.56
+B16	1.90	4.82	3.52	1.18	.868
+B17	0	.406	.525	.173	.127
+B18	0	.137	.233	.060	.044
+B19	0	3.62	1.96	.572	.421
+B20	0	0	0	.325	.461
+B21	0	1.28	1.82	1.11	1.45
+B22	0	0	.525	.136	.100
+B23	0	.225	.509	.171	.125
2BB1	0	0	0	1.55	1.87
3BB1	0	0	0	.754	1.07
37BB1	0	0	0	.780	.574
4BB1	0	0	0	.061	.045
48BB1	0	0	0	.055	.040
2BB3	0	.182	.171	.211	.155
3BB3	.633	7.56	7.70	3.26	2.40
37BB3	0	0	0	.728	.535
3⑦BB3	0	.182	1.19	.307	.225
38BB3	0	0	0	.126	.093
338BB3	0	0	0	.331	.244
4BB3	0	.930	1.35	.349	.343
4⑦BB3	0	0	.131	.034	.025
48BB3	0	0	.243	.286	.210
4⑧BB3	0	.425	.230	.059	.044
⑨BB3	0	0	0	.039	.029
2BB5	0	0	0	.491	1.213
3BB5	0	0	0	.067	.276
2BB6	0	0	0	.180	.132
3BB6	0	0	0	1.04	.763
38BB6	0	0	0	.173	.127
4BB6	0	0	0	.167	.123
5BB6	0	0	0	.042	.031
2BB10	0	0	0	.024	.017
3BB10	0	.030	.016	.073	.054
33⑦BB10	0	0	0	.013	.010
2BB12	0	0	0	.020	.015
3BB12	1.44	.097	.053	.038	.028
33BB12	0	.225	.453	.189	.139
33⑧BB12	0	0	.138	.036	.026
4BB12	0	.213	.306	.079	.058
47BB12	0	.026	.057	.015	.011
4⑦BB12	0	0	.207	.053	.039
2BB13	0	.195	.105	.027	.020
47BB13	0	0	0	.023	.017
+BB15	0	0	.102	.026	.019
+BB16	0	0	0	.026	.019
3BB17	0	0	0	.012	.008
+BB19	0	.116	.063	.016	.012
+BB21	0	0	0	.237	.174
2C1	0	0	0	.136	.100
3C1	0	0	0	.034	.025
2C3	0	0	0	.065	.048
3C3	0	0	0	.035	.026
2C6	0	0	0	.077	.056
3C6	0	0	0	.134	.098
4C6	0	0	0	.026	.019
2D1	0	0	0	.066	.049
2⑦D1	0	0	0	.099	.073
2D9	0	0	0	.141	.104
2⑦D9	0	0	0	.040	.041
2D10	0	0	0	.037	.027
2D11	0	0	0	.015	.011
+D20	0	0	0	.475	.421
+D21	0	0	0	.777	1.14

Table 9.—*Percentage of watersheds Z, Y, and W in each land separation*

Map symbol	Watershed												
	Z	Y	Y2	Y4	Y6	Y7	Y8	Y10	W1	W2	W6	W8	W10
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
2A1	0.05	2.62	5.47	2.60	10.12	8.68	21.71	0	11.02	2.59	0	8.00	16.06
27A1	0	.10	.23	0	0	0	0	0	0	0	0	0	0
2A2	0	0	0	0	0	0	0	0	0	2.41	0	6.67	11.06
2A5	.46	0	0	0	0	0	0	0	0	0	0	0	0
+A20	0	.24	0	0	0	0	0	0	0	0	0	0	0
2B1	0	0	0	0	0	0	0	0	0	2.09	0	3.21	0
27B1	64.79	54.28	52.16	54.18	14.28	75.85	50.42	85.21	50.82	57.30	98.66	31.71	44.40
2⑦B1	.99	0	0	0	0	0	0	0	0	0	0	0	0
3B1	.45	1.81	4.53	2.13	0	0	11.80	0	0	0	0	0	0
37B1	0	0	0	0	0	0	0	0	.75	0	0	0	0
2B2	0	0	0	0	0	0	0	0	0	6.84	0	9.66	19.41
3B2	0	0	0	0	0	0	0	0	0	1.86	0	4.96	7.91
2B5	16.42	12.17	0	0	0	15.47	0	0	21.64	4.87	0	15.53	0
3B5	1.17	.63	0	0	0	0	0	0	1.17	0	0	0	0
4B5	.19	0	0	0	0	0	0	0	0	0	0	0	0
2B6	0	1.27	0.92	1.50	5.86	0	0	0	0	0	0	0	0
3B6	0	6.88	5.76	0	0	0	5.04	0	0	0	0	0	0
38B6	0	.99	2.29	3.74	14.57	0	0	0	0	0	0	0	0
4B6	0	.50	.45	0	0	0	0	0	0	0	0	0	0
+B20	1.35	.25	.45	0	0	0	0	0	.20	.62	0	0	0
2BB1	1.62	3.35	5.10	6.91	10.22	0	0	1.05	3.84	4.31	0	4.44	0
3BB1	0	3.58	7.76	8.00	0	0	9.08	7.69	0	3.45	0	8.51	.58
2BB2	0	0	0	0	0	0	0	0	0	2.22	0	0	0
3BB2	0	0	0	0	0	0	0	0	0	2.67	0	2.87	.58
2BB5	12.51	2.41	0	0	0	0	0	0	10.56	7.79	1.34	1.33	0
3BB5	0	0	0	0	0	0	0	0	0	.98	0	3.11	0
2BB6	0	.58	.75	.69	0	0	1.95	0	0	0	0	0	0
3BB6	0	5.25	6.98	8.59	2.05	0	0	3.51	0	0	0	0	0
38BB6	0	2.49	5.77	9.40	35.57	0	0	1.10	0	0	0	0	0
4BB6	0	.60	1.38	2.26	7.33	0	0	1.44	0	0	0	0	0

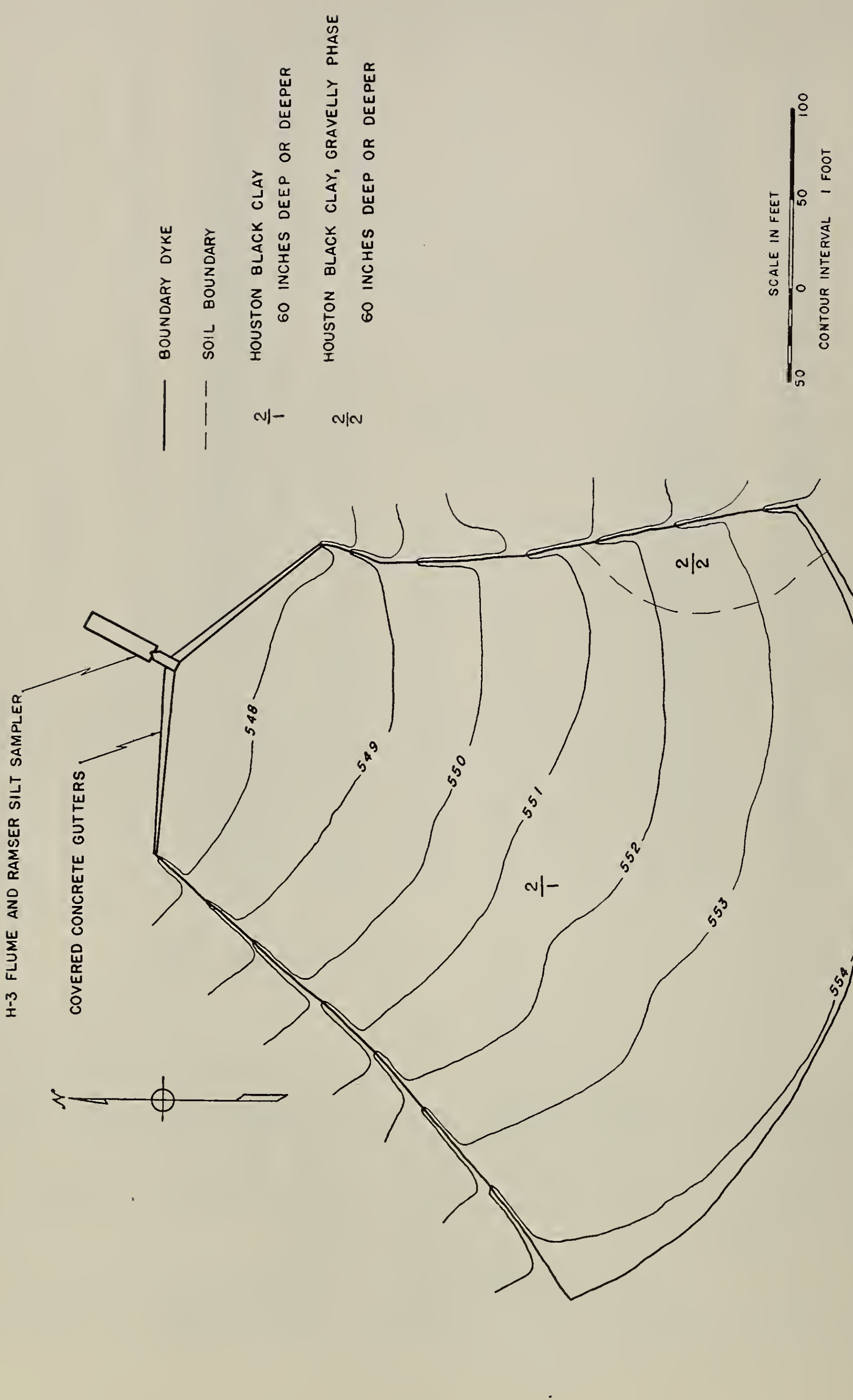


Figure 6.—Topography and soil, watershed 2.

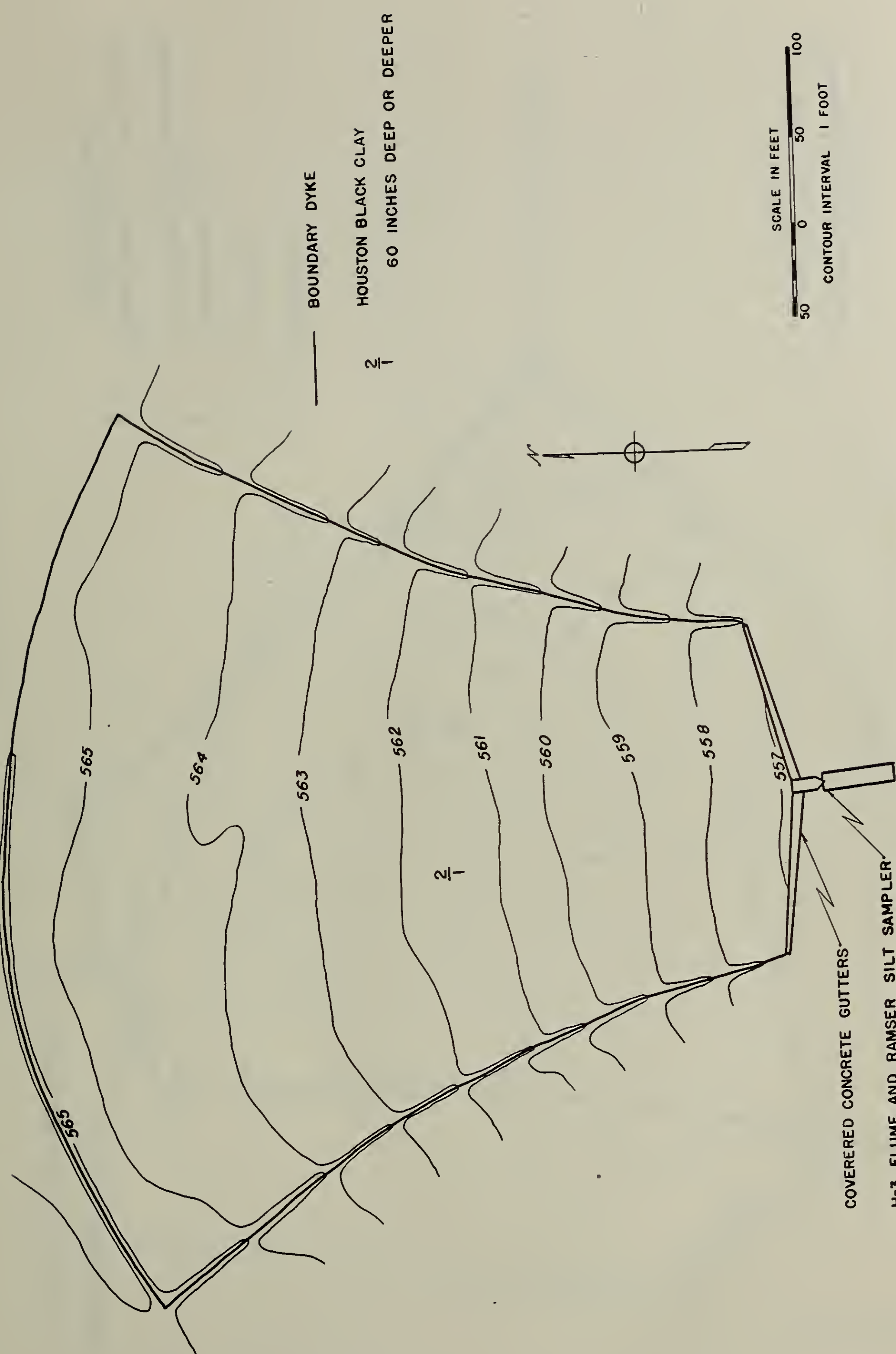


FIGURE 7.—Topography and soil, watershed 3.

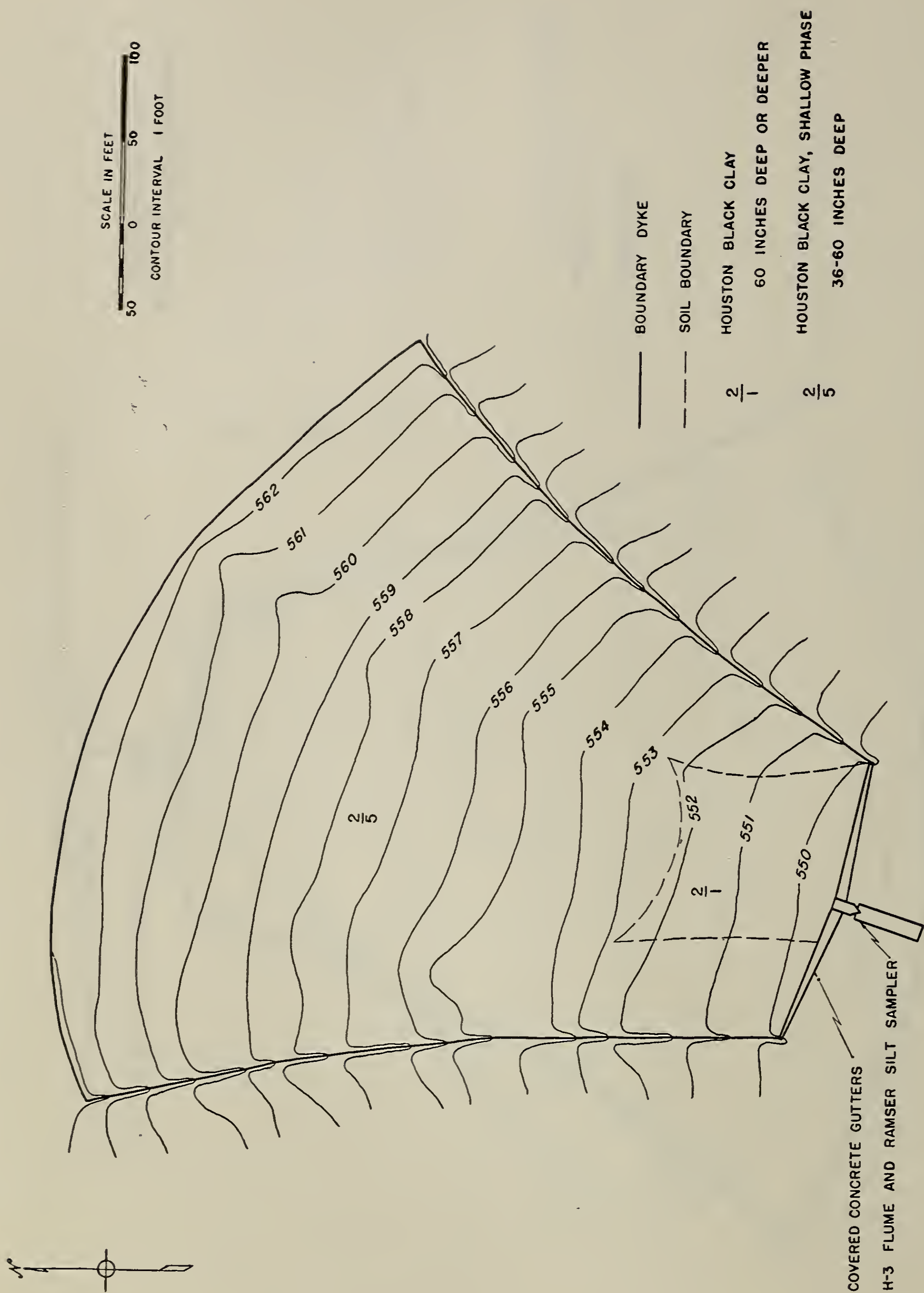


FIGURE 8.—Topography and soil, watershed 5.

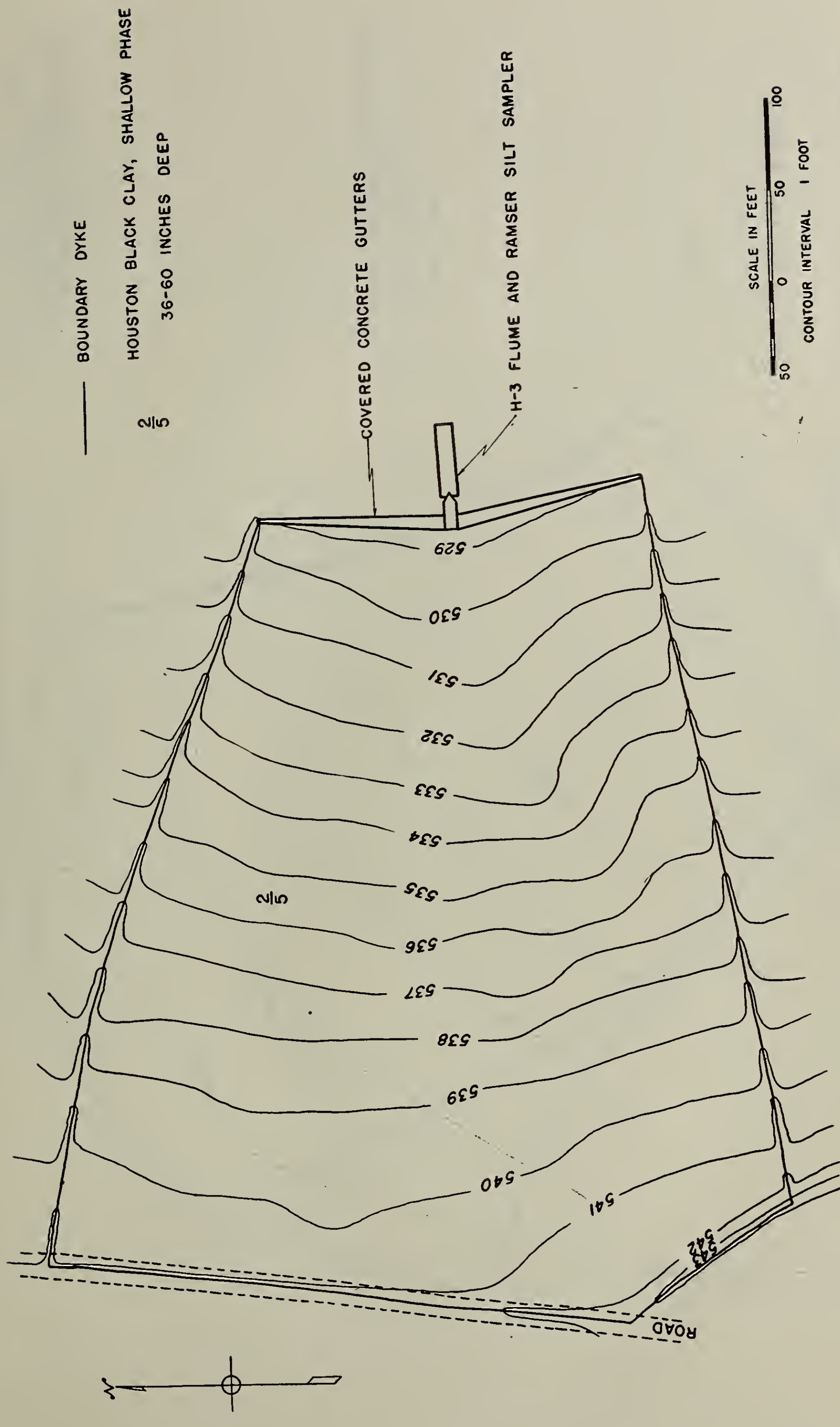


FIGURE 9.—Topography and soil, watershed 6.

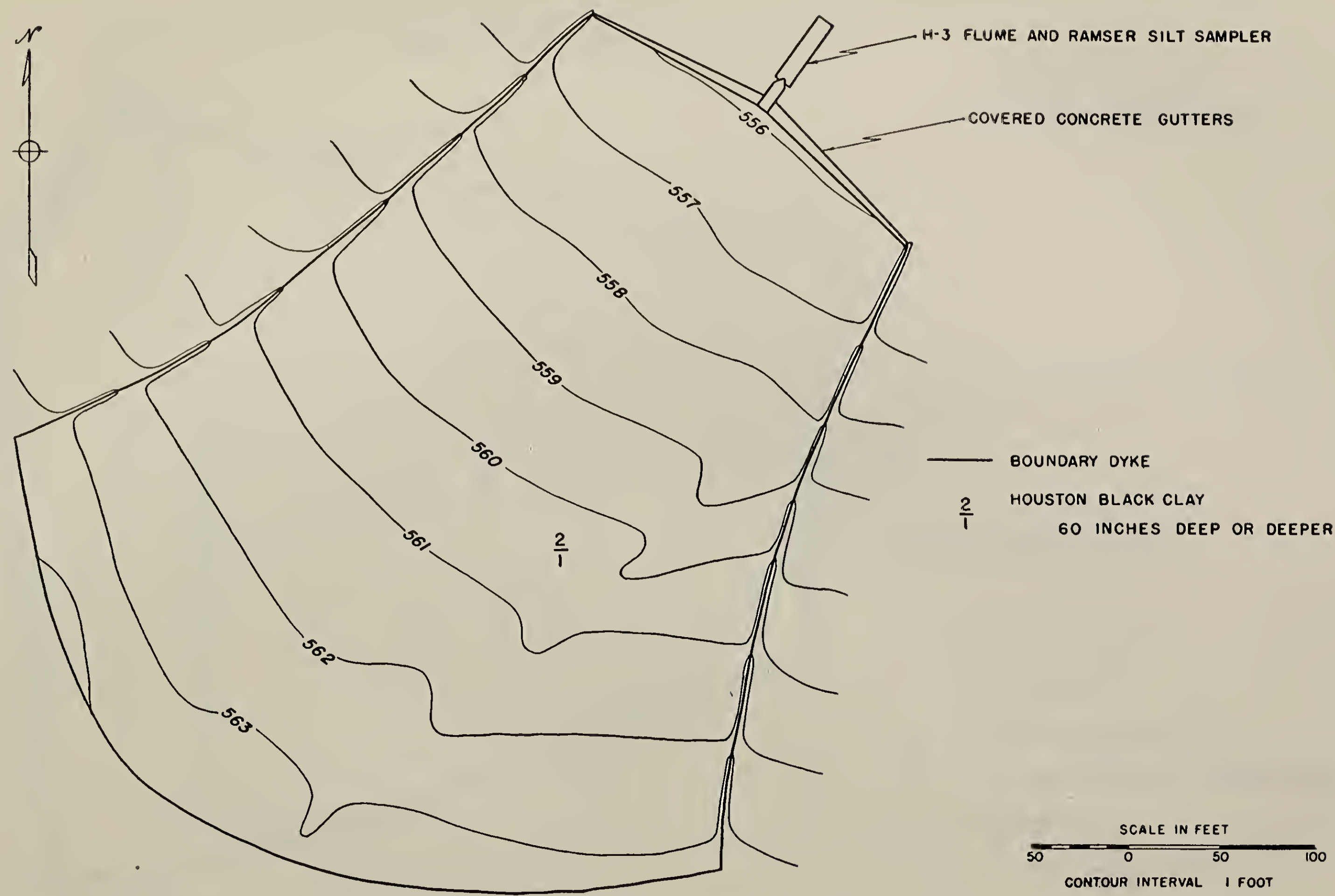


FIGURE 10.—Topography and soil, watershed 7.

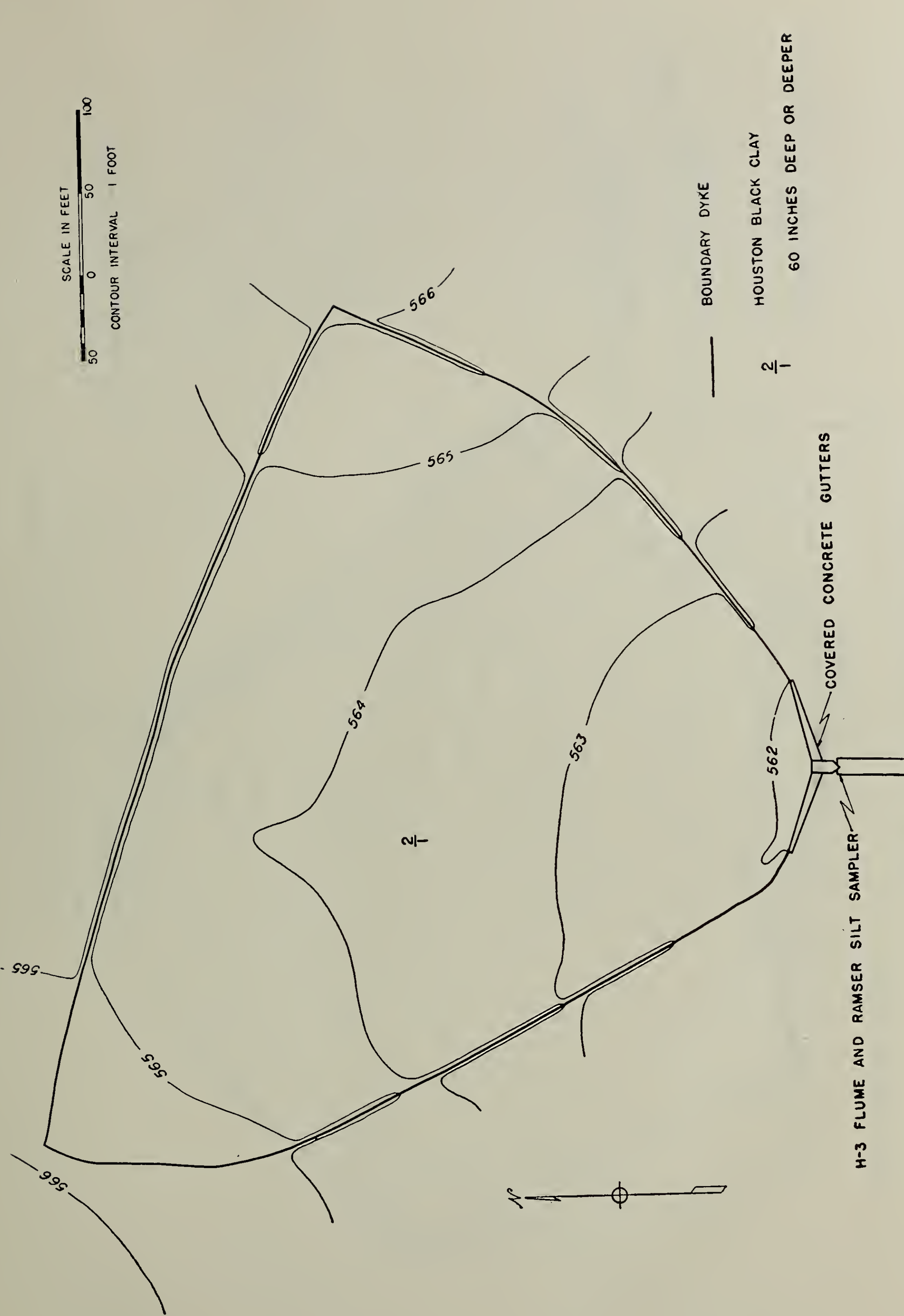


FIGURE 11.—Topography and soil, watershed 11.

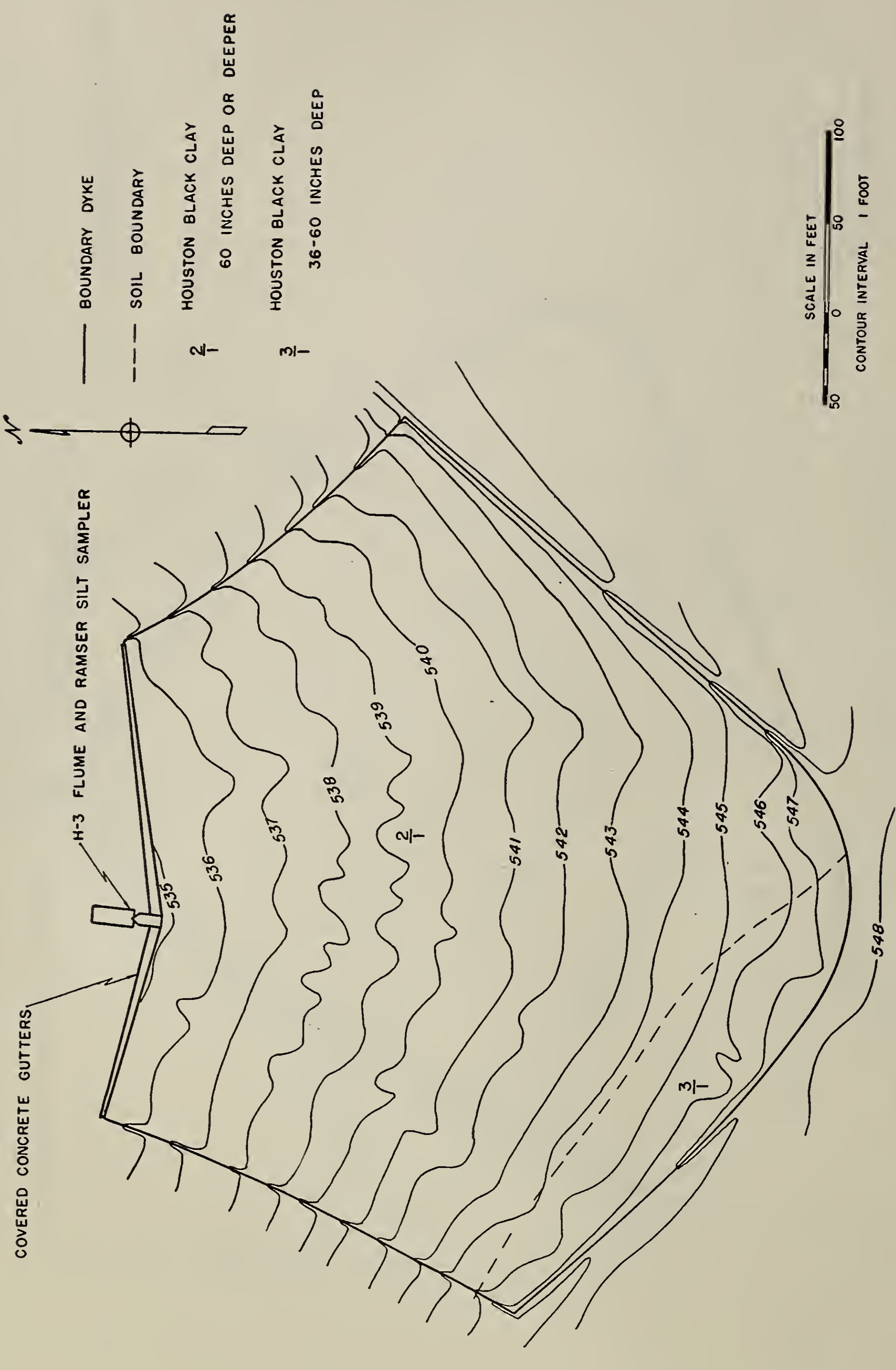


Figure 12.—Topography and soil, watershed 12.

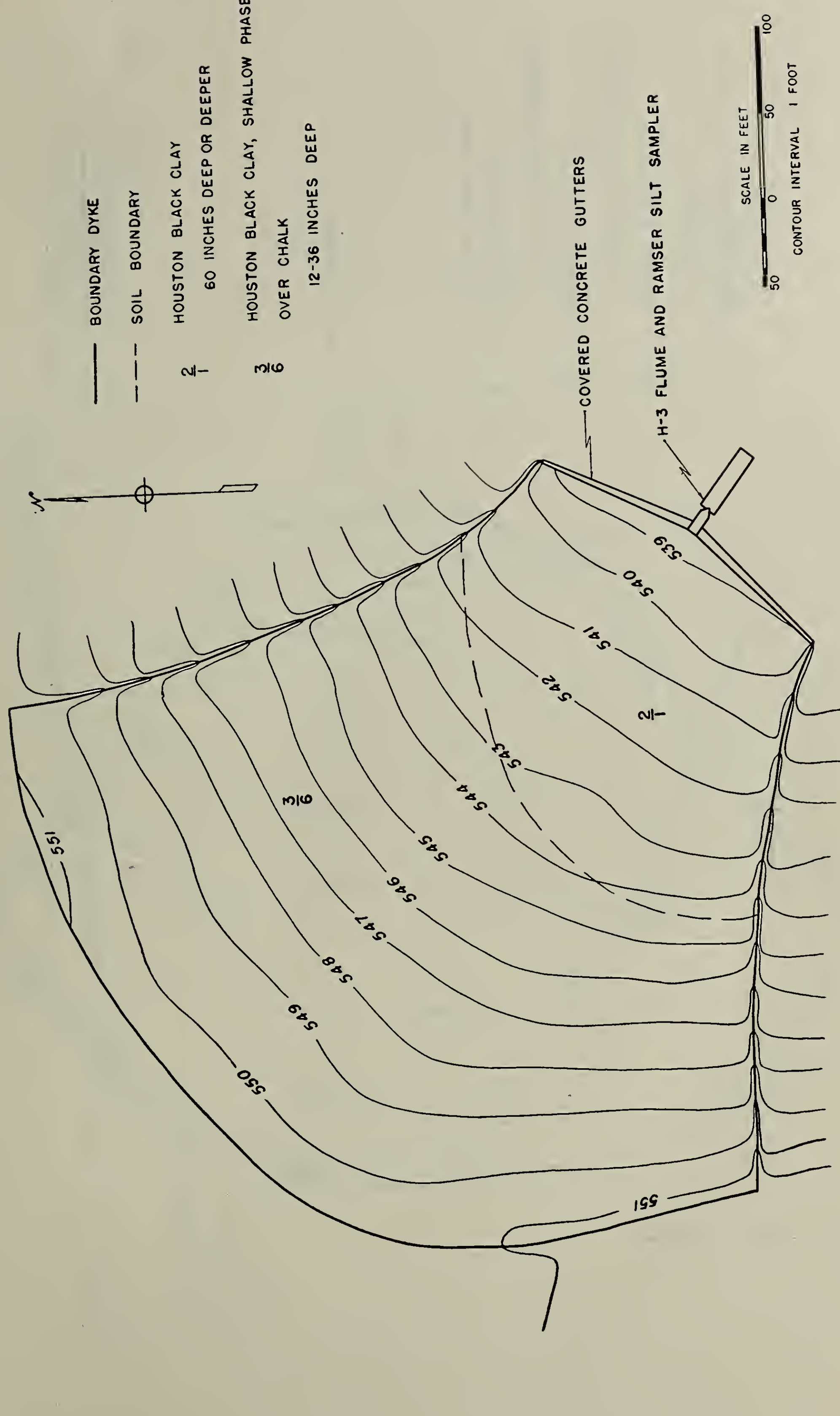


Figure 13.—Topography and soil, watershed 13.

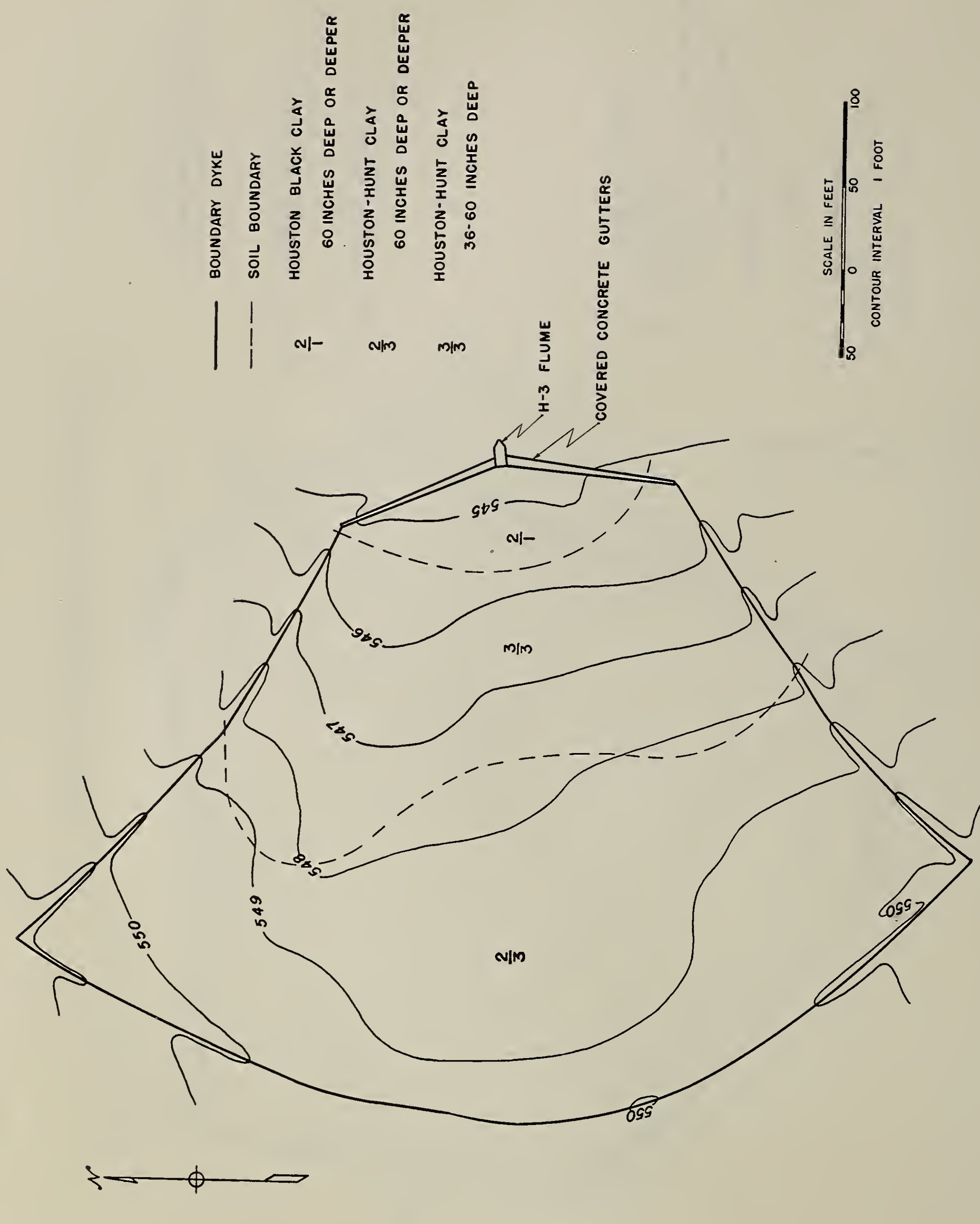


FIGURE 14.—Topography and soil, watershed 14.

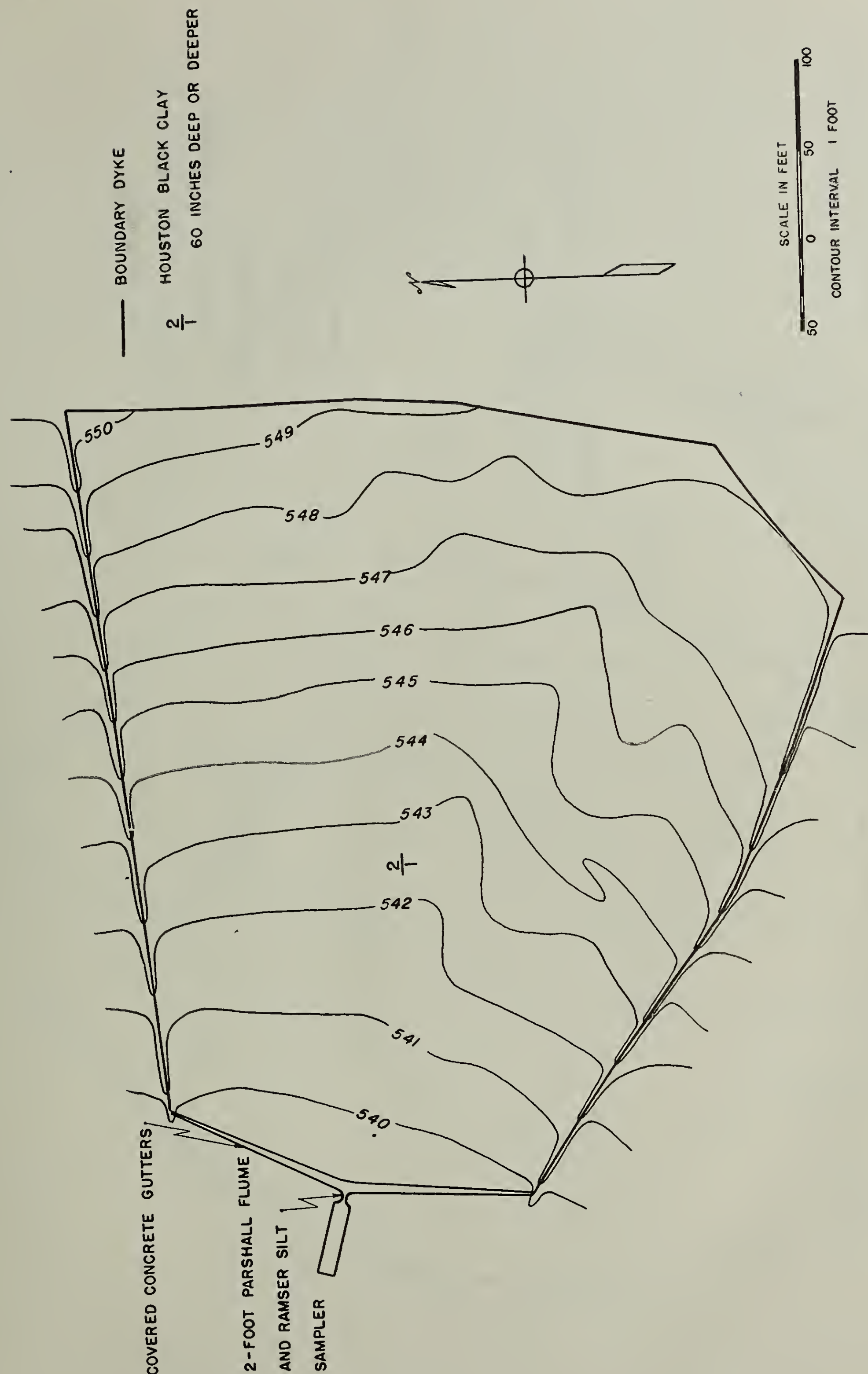


FIGURE 15.—Topography and soil, watershed 16.

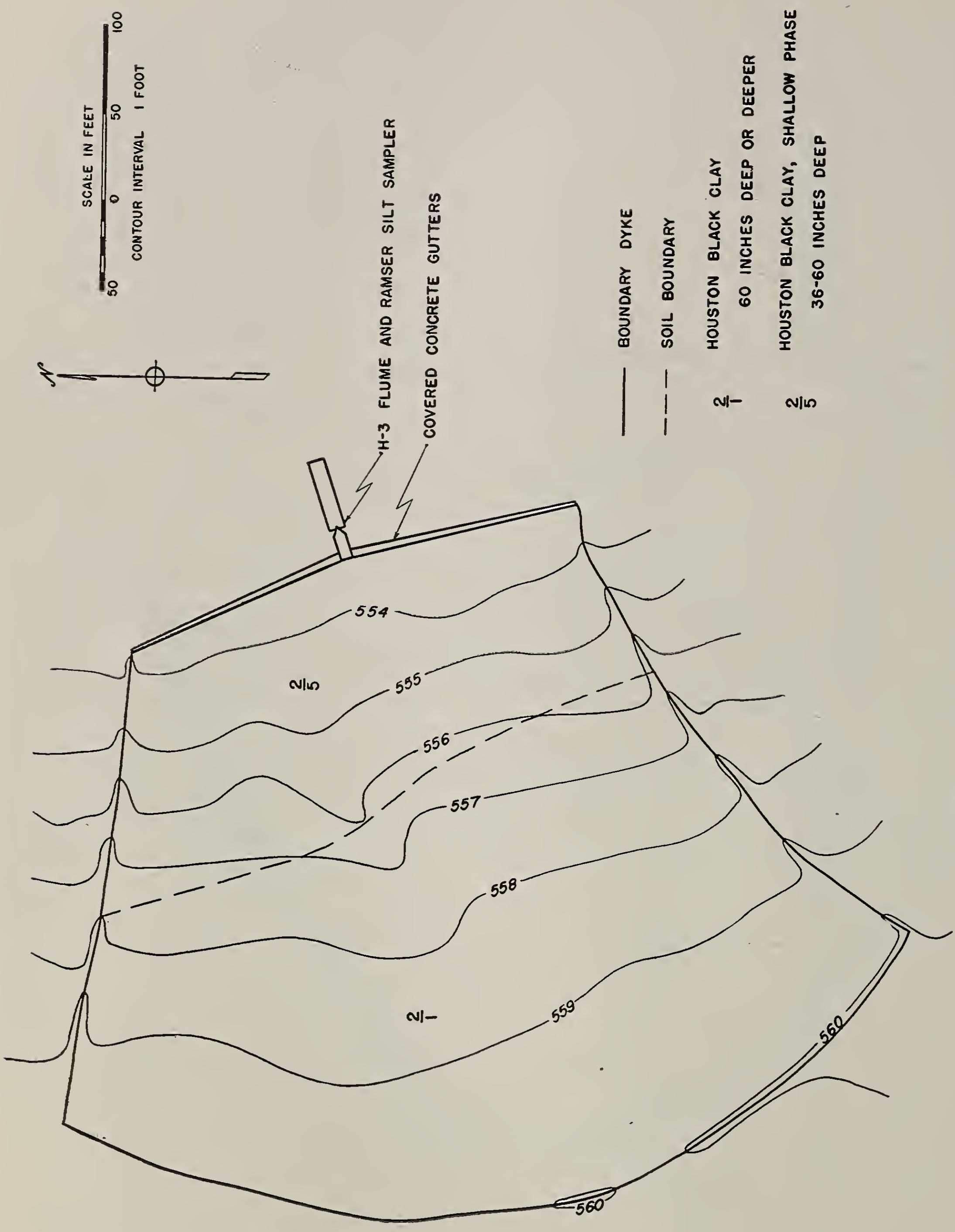


FIGURE 16.—Topography and soil, watershed 17.

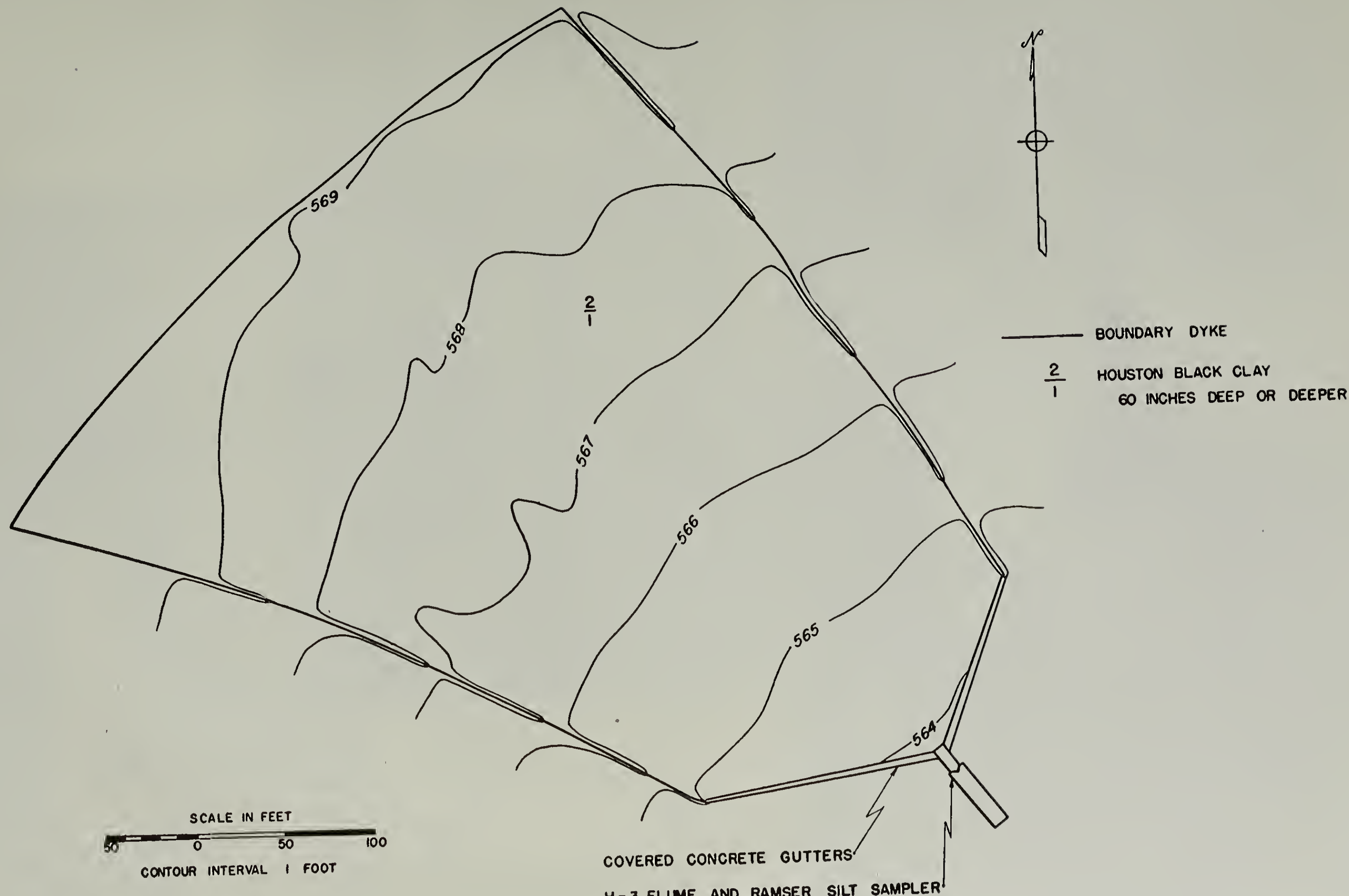


FIGURE 17.—Topography and soil, watershed 18.

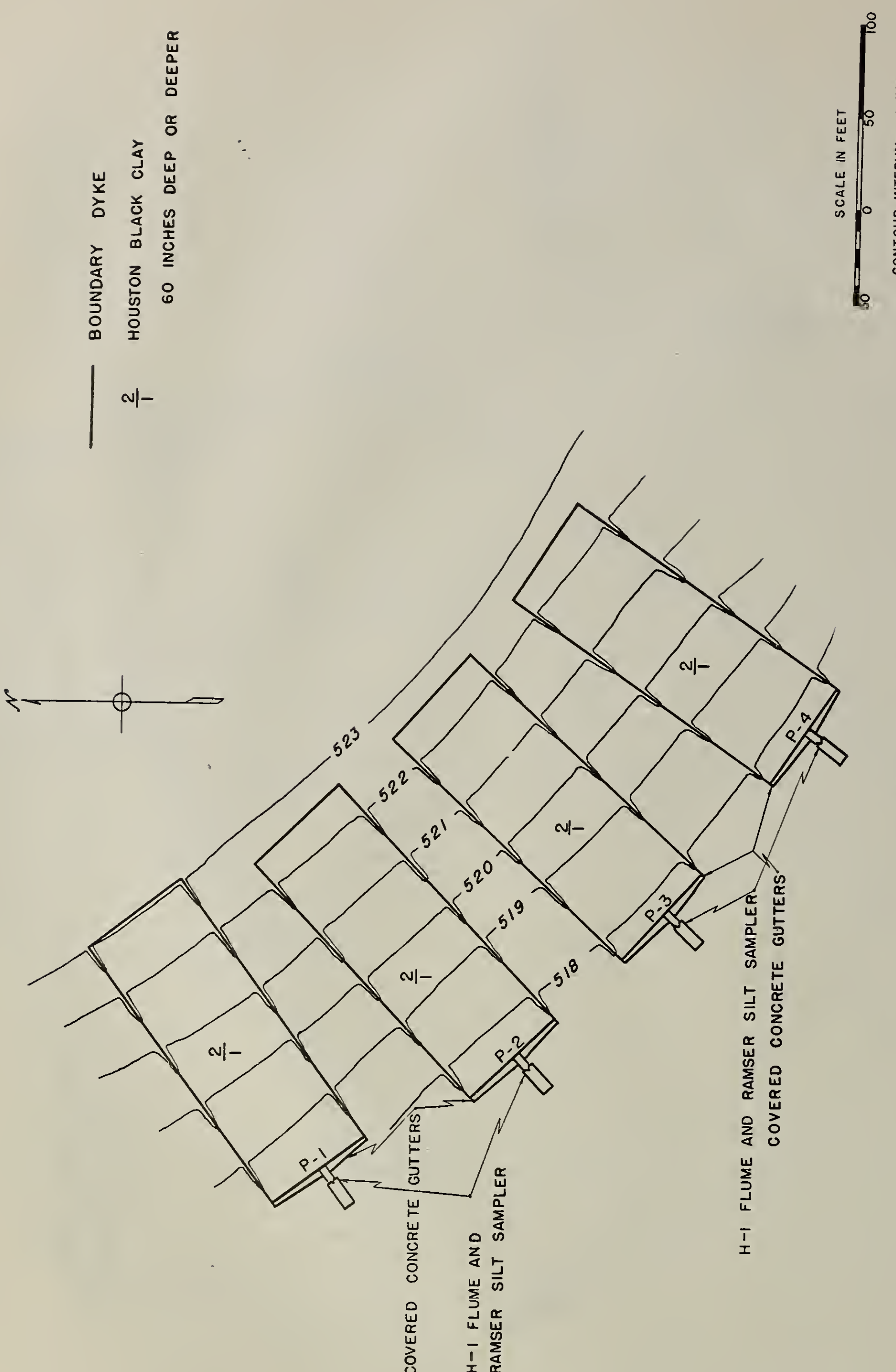
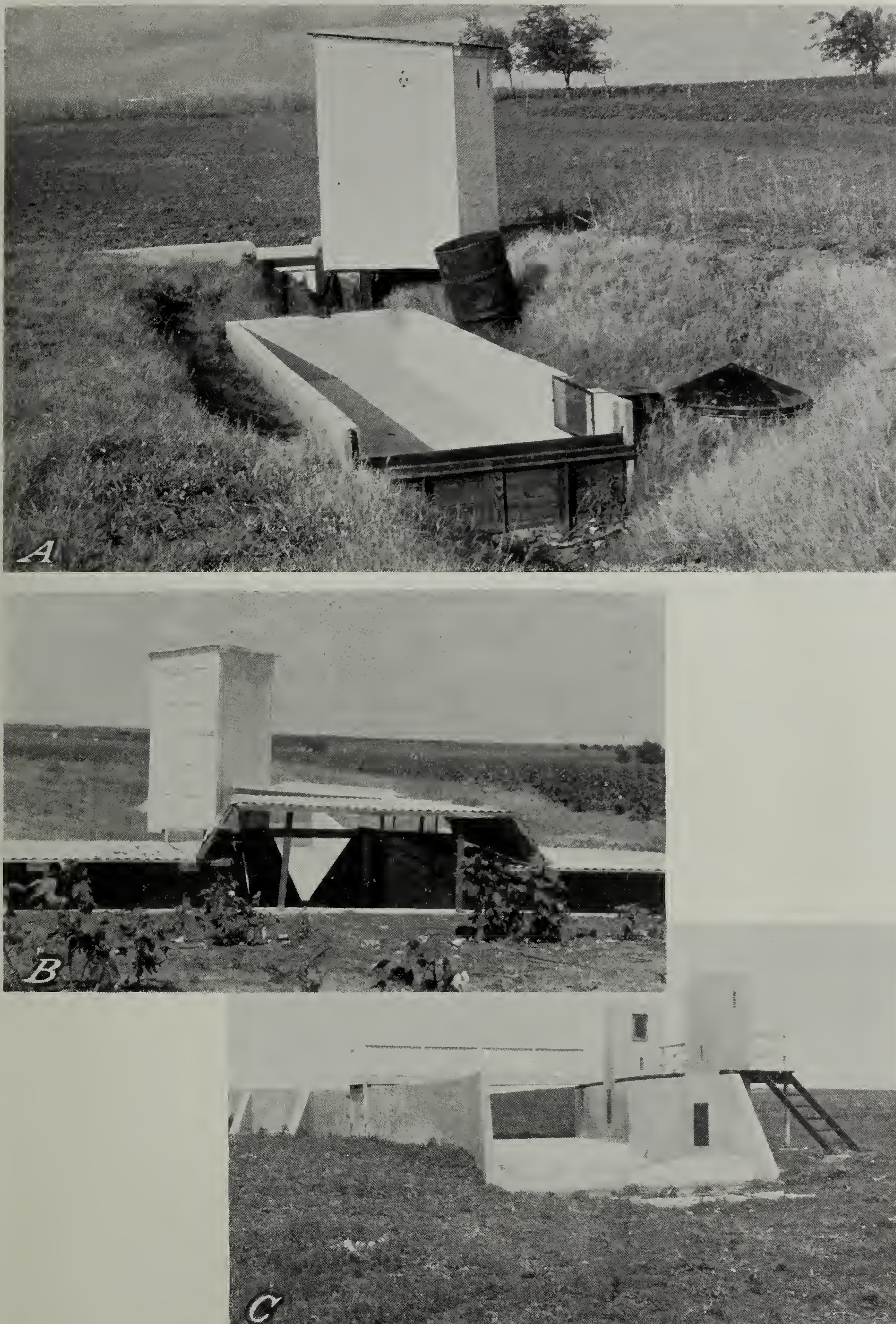
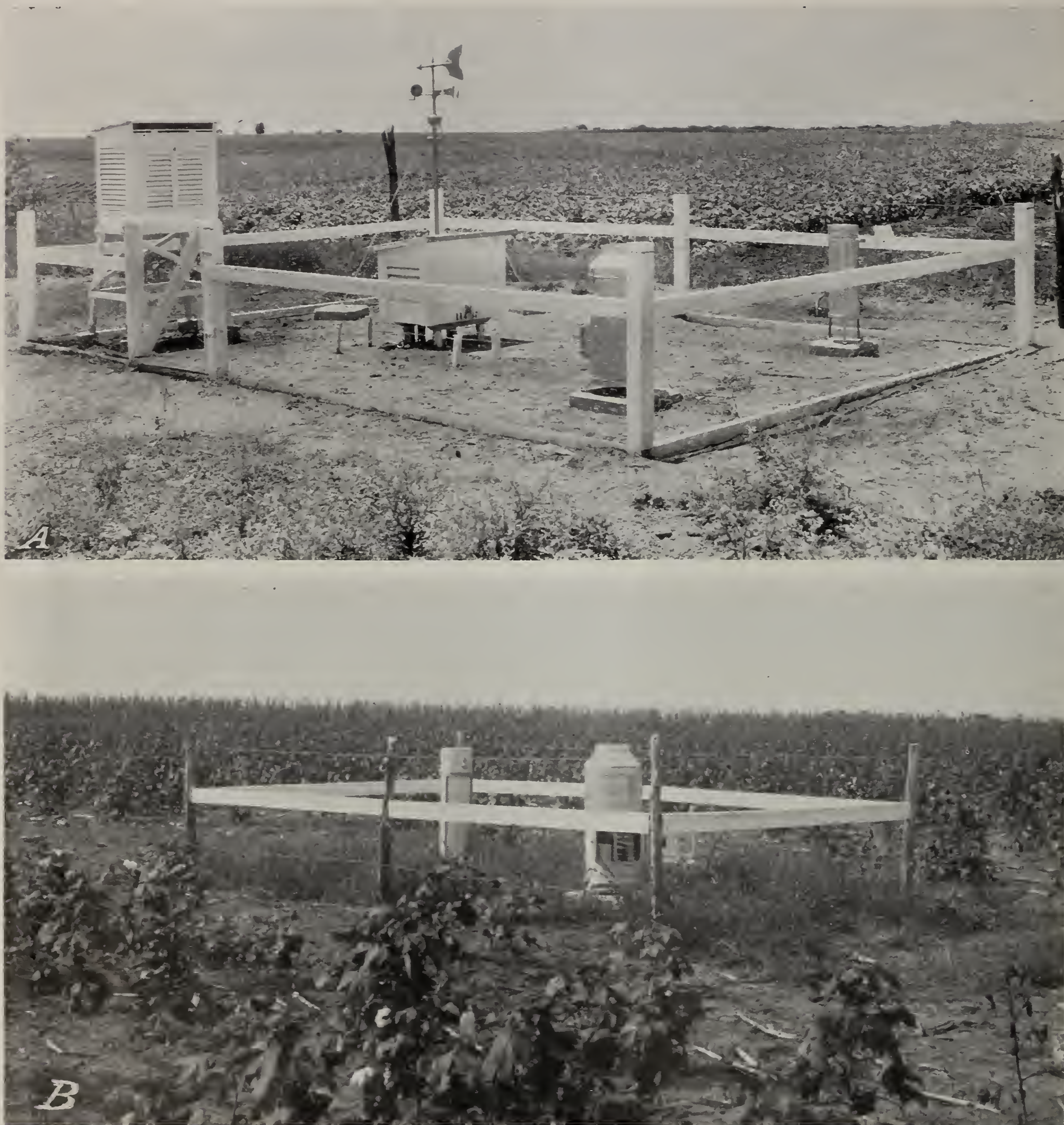


Figure 18.—Topography and soil, plots P1, P2, P3, and P4.



A, H–1 flume and Ramser silt sampler at ¼-acre plot P4. The concrete collecting gutters and the flume and flume-approach section have since been covered to eliminate from the record the run-off from rain falling on these impervious areas. *B*, H–3 flume, Ramser silt sampler, and gutter covers at 3-acre watershed 7. In the foreground are cotton plants. *C*, 5-foot modified Parshall flume with 1-on-5 Columbus weir at station Y–2, looking upstream.

A, Looking upstream at the low-water control, channel, recorder shelter, and footbridge at station J. Run-off from 5,860 acres passes this station. *B*, Looking upstream at the low-water control, channel, recorder shelter, and footbridge at station C. Run-off from 579 acres passes this station. *C*, Typical installation for recording fluctuations of the ground-water level at well 663.



A, Rain gages, anemometer, soil thermograph, and instrument shelters at station 14: *B*, recording and standard nonrecording rain gages at station 82.

Surface run-off is measured at 34 stations at the outlets of drainage areas that range from ¼ acre to 5,860 acres. Six stations measure run-off from private land and 28 from Government land where cultural and operating conditions can be controlled. Measurements of ground-water elevations are made at 17 wells, one of these being outside the area shown on the map. Rain gages have been installed over the area to measure precipitation. The locations of the surface run-off measuring stations, the rain gages, and the wells are shown on figures 4 and 5. In table 10 the drainage area, the type of run-off measuring station, the number of rain gages and wells, and the method by which soil material transported by water is measured are shown for each watershed.

Three general types of installations are used at the various surface run-off measuring stations. For small areas of about 3 acres or less, an H flume and a water-stage recorder are used to measure run-off and a Ramser silt sampler to determine the amount of soil washed from the area. Two views of this equipment as installed are shown in plate 3, *A* and *B*.

TABLE 10.—*Instrumentation on each watershed, Dec. 31, 1940*

Watershed	Area	Run-off measuring station [1]				Rain gages		Ground-water wells [3]		Silt-measuring device			
		Date record started	Location		Station type [2]	Recording	Nonrecording	Recording	Nonrecording	Type	Size of silt box		
			Latitude	Longitude							Length	Width	Depth
	Acres		° ′ ″	° ′ ″		*Number*	*Number*	*Number*	*Number*		*Feet*	*Feet*	*Feet*
A	42.0	May 13, 1938	31 32 10	96 53 33	PFW	1	1	0	0	Spot [4]			
C	579	Dec. 16, 1937	31 31 11	96 53 34	Ow-cm	3	9	0	0				
D	1,110	Nov. 12, 1937	31 30 38	96 53 22	Ow-cm	5	20	1	0	Spot [4]			
G	4,380	Nov. 6, 1937	31 28 59	96 52 06	Ow-cm-s	21	54	6	2				
J	5,860	June 24, 1937	31 27 54	96 50 59	Ow-cm-s	23	78	8	2	Spot [4]			
Z	310	May 5, 1939	31 28 08	96 51 44	Vw-cm	2	6	0	0	do.[4]			
Y	309	Apr. 22, 1937	31 28 36	96 52 36	Ow-cm	11	0	5	2	do.[4]			
Y2	132	Oct. 4, 1938	31 28 30	96 52 46	PFW	5	0	1	1				
Y4	79.9	Oct. 5, 1938	31 28 30	96 52 54	PFW	4	0	0	1				
Y6	20.9	Sept. 16, 1938	31 28 26	96 53 09	PFW	1	0	0	0	Spot [4]			
Y7	40.0	Dec. 16, 1938	31 28 08	96 52 49	PFW	2	0	0	0				
Y8	20.8	Mar. 2, 1939	31 28 22	96 52 54	PFW	1	0	1	0				
Y10	21.0	July 12, 1938	31 28 31	96 53 10	PFW	1	0	0	1	Spot [4]			
W1 and W2	306	June 23, 1937				13	0	6	0	do.[4]			
W1	176	June 22, 1937	31 27 27	96 52 48	PFW	9	0	6	0	do.[4]			
W2	130	June 23, 1937	31 27 19	96 52 55	PFW	6	0	0	0	do.[4]			
W6	42.3	May 3, 1939	31 27 24	96 53 11	PFW	2	0	0	0				
W8	40.4	July 11, 1938	31 27 21	96 52 56	PFW	2	0	0	0	Spot [4]			
W10	19.7	July 12, 1938	31 27 12	96 53 00	PFW	1	0	0	0	do.[4]			
2	2.70	Apr. 1, 1938	31 27 21	96 53 13	H-3	1	0	0	0	Ramser	40	8	2
3	3.09	Dec. 7, 1938	31 27 29	96 53 12	H-3	1	0	0	0	do	40	8	2
5	3.09	Oct. 1, 1938	31 27 46	96 53 00	H-3	1	0	1	0	do	40	8	2
6	3.04	Nov. 9, 1938	31 27 13	96 52 47	H-3	1	0	0	0	do	40	8	2
7	3.15	Mar. 9, 1938	31 28 11	96 52 59	H-3	1	0	1	0	do	40	8	2
11	3.23	Mar. 2, 1938	31 28 02	96 53 04	H-3	1	0	0	0	do	40	8	2
12	2.97	Dec. 15, 1937	31 28 48	96 52 59	H-3	1	0	0	0	do	20	8	2
13	3.19	Mar. 8, 1938	31 28 41	96 52 48	H-3	1	0	0	0	do	40	8	2
14	3.02	Mar. 9, 1939	31 28 59	96 53 27	H-3	1	0	0	0				
16	3.17	Sept. 24, 1937	31 28 37	96 53 22	PF	1	0	0	0	Ramser	40	8	2
17	2.99	Feb. 6, 1939	31 27 45	96 53 14	H-3	1	0	1	0	do	40	8	2
18	3.04	Apr. 2, 1938	31 28 04	96 53 07	H-3	1	0	0	0	do	40	8	2
P1	.243	June 8, 1938	31 27 25	96 52 35	H-1	1	0	0	0	do	16	5	1.5
P2	.243	do	31 27 24	96 52 34	H-1	1	0	0	0	do	16	5	1.5
P3	.243	do	31 27 23	96 52 33	H-1	1	0	0	0	do	16	5	1.5
P4	.243	do	31 27 22	96 52 32	H-1	1	0	0	0	do	16	5	1.5

[1] Each station has a Friez type FW-1 water-stage recorder operating on a chart scale of 1 inch equals 25 minutes and 1 inch equals 0.2-foot stage. These recorders have vertical drums that make 1 revolution each 6 hours.

[2] PF, Parshall flume. PFW, Combination Parshall flume—Ogee weir. Ow-cm, Ogee weir—current meter. Ow-cm-s, Ogee weir—current meter—slope station. Vw-cm, V-notched weir—current meter. H-3, H flume, 3 feet deep. H-1, H flume, 1 foot deep.

[3] Records from all but these 14 recording and 2 nonrecording wells and 1 nonrecording well outside the area were discontinued Oct. 1, 1940.

[4] The sample is obtained from a milk bottle that has been lowered into and removed from the stream bed at such a speed that it is not quite full when it reaches the surface.

For areas of about 20 to 200 acres, a modified Parshall flume is used to measure surface run-off. The upper part of this flume is identical with the standard Parshall flume and its record is used for the high rates of flow. To measure low flow accurately, either a deep notch or a 1-on-5 Columbus weir located in the recovery section of the flume is used. Water-stage recorders give continuous records of stage at both the flume and the Columbus weir. Manually collected silt samples are obtained at some of these stations to determine the amount of soil in the run-off water. A typical flume station is shown in plate 3, *C*.

For stations with drainage areas greater than 300 acres, a Columbus or a V-notch weir is used to measure low flows and rating curves developed by current-meter measurements are used for determining discharges at

higher stages. In addition to the regular water-stage recorder at the station, slope recorders are in use at stations G and J where water-surface slope affects the stage-discharge relationship. Typical stations of this type are shown in plate 4, *A* and *B*.

About 200 auger holes, generally 15 to 30 feet in depth, have been bored to explore the geology and ground water of the area. More than 100 of these were converted into ground-water observation wells by casing with 6- or 8-inch steel pipe perforated near the lower end. Three wells, Nos. 1010, 1011, and 1012, were drilled to depths of 160, 200, and 160 feet, respectively. Recorders were installed at 39 wells, and the recorder shelters were attached to the well casings with pipe flanges. A typical installation of this kind is shown in plate 4, *C*. Regular measurements of the depth to water were obtained at these wells and also at more than 50 farm wells. Regular records at all but 14 recording and 3 nonrecording wells were discontinued October 1, 1940.

Rainfall records are obtained with recording and standard nonrecording rain gages. Typical installations are shown in plate 5. A standard rain gage is installed at all stations where recording rain gages are used. At stations 14 and 107, continuous records of air temperature and records of daily wind movement are obtained. At stations 27 and 31 maximum and minimum daily temperatures are recorded.

On the 841.13 acres of Government land, on which the more intensive studies are being made, there are laboratory facilities for investigating the properties of soil related to soil and water conservation and for determining the soil material in run-off samples. The meteorological equipment, including an anemograph, a sunshine-duration recorder, a mercurial barometer, and a recording barograph, is housed in one building. In the yard wind movement at 7 feet and at 1½ feet above the ground is obtained with cup anemometers; evaporation is measured by United States Weather Bureau, Bureau of Plant Industry, and Colorado evaporation pans; and air temperature and relative humidity are obtained by maximum and minimum thermometers, sling psychrometers, and a recording hygrothermograph.

APPENDIX

DESCRIPTION OF SOIL TYPES

HOUSTON BLACK CLAY

Houston black clay is confined largely to the southeastern two-thirds of the watershed and is by far the most extensive soil in the area. In virgin areas approximately the first 6 inches consist of a turf that is relatively porous and high in organic matter. The surface soil, to a depth of 12 to 36 inches, is a blackish-gray calcareous clay that grades into slightly lighter colored dark-gray, heavy, calcareous clay. At a depth ranging from 3 to 5 feet this material grades into yellow or brownish-yellow marl. In places the layer of yellow marl is wavelike, reaching to within a few inches of the surface, whereas the calcareous black clay between these waves is several feet deep.

The surface of areas that have never been plowed is very uneven. This surface condition is referred to locally as hogwallow. The pattern of the depressions on the ridge tops, where the slope is slight, consists of a series of oval depressions. These hold water for a considerable time following a rain when the moisture deficit of the soil is fully satisfied. Plate 2, *E*, shows water standing in some of these oval depressions. The rough surface on the more sloping areas is ascribable to a series of furrowlike depressions extending down the slope normal to the contour of the land. The spacing of these depressions is fairly uniform and during periods of run-off they function as a series of approximately parallel small channels, conducting the water to the base of the slope.

When wet the surface soil is exceedingly tenacious. On drying the soil breaks down to fine granules, and when cultivated under proper moisture conditions the surface layer becomes a friable loamy mass. Although the clay surface soil and subsoil are both very heavy in texture and fairly dense, the granular structure allows a more ready access of air, water, and plant-roots to all parts of the soil mass than would be possible otherwise.

The surface relief is undulating to gently rolling, the slope ranging from 0 to 6 percent, the greater part of the acreage having a slope of 1 to 3 percent. The slopes are long and uniform. The drainage units that are made up mostly of Houston black clay and closely related soil types are relatively large. Drainage systems in watersheds of less than 100 acres are generally not well defined. The drainageways are of the single-branch type. The channels are subject to shifting and are bordered on either side by broad flood plains and wide benches of nearly flat land.

Throughout the profile rounded quartzite gravel and shell fragments are commonly present. Where a sufficient quantity of gravel is present to be markedly noticeable another separation is made that is designated as Houston black clay, gravelly phase.

In areas where the substratum is alluvial marl or marl strata of the sandy-marl member [9] there is a zone of calcium-carbonate deposition just above the slightly weathered substratum, which usually occurs at depths of 5 or more feet. This is evidenced by the presence of calcium carbonate concretions, soft white lumps in places, and occasional veinlike accumulations of calcium carbonate. It would seem that the veinlike accumulations are the result of the precipitation of calcium carbonate from charged waters, which at times occupy cavities in this zone.

Permeability varies widely with the soil-moisture content. After a period of dry weather, numerous cracks, which at times may extend to the slightly weathered substratum, make the soil highly permeable (pl. 2, *D*). At such times heavy rains may produce little or no run-off. It is believed the effect of such an antecedent condition is reflected in greater soil permeability for some time, even after the moisture deficit has been largely removed by precipitation. After extended periods in which the soil remains wet, it becomes a relatively impermeable plastic mass and storms may produce run-off nearly equal to the precipitation. Although surface drainage is rapid, internal drainage is slow because of the relative impermeability of the soil and substratum material.

The soil is highly erodible, great quantities of soil being transported as the result of a single rain that produces run-off. Sheet erosion predominates; gullies are not formed to any extent unless the water is artificially concentrated. The factors that contribute to the erodibility of the soil are: The relative impermeability of the solum and substratum after extended wet periods, the granular character of the soil material, its characteristic of slaking down on drying, and the low volume weight of the surface soil. Heavy rains, especially when the soil is dry and loose, as tilled soil after a dry period, literally float the soil away. Once a gully has been formed, much destructive erosion occurs as a result of large blocks sloughing from the sides. This is brought about by extended dry periods followed by rains. The cracks which develop leave columns of soil practically isolated and the rain then disintegrates the slight attachment to the main mass with the result that the detached columns tip over into the bottom of the gully. This process is illustrated by plate 2, *A*, *B*, and *C*.

The inherent chemical properties of the soil that are responsible for its granular character contribute to the rapid settling of suspended material when the velocity of the transporting run-off water is reduced. Probably for this reason, considering the texture of the soil, most of the eroded material is not moved great distances but tends to be deposited at the base of slopes. Freshly deposited soil material may have the appearance of sand and be taken for sand unless carefully examined, although a mechanical analysis will show it to contain less than 10 percent of sand.

HOUSTON BLACK CLAY, GRAVELLY PHASE

Houston black clay, gravelly phase, occupies a very small acreage in the extreme southern part of the area purchased by the government and is confined to one ridge top.

The solum is 60 inches or deeper, consisting of a blackish-gray calcareous clay becoming slightly lighter in color with depth. Throughout the surface a considerable quantity of rounded quartzite gravel is present, extending in lesser amounts into the solum to variable depths, although generally not to any extent below 24 inches. The substratum is similar to that of the Houston black clay, with which this soil type is associated.

[9] See pages 6 and 9.

With respect to utilization it is identical with the Houston black clay. With respect to drainage and erodibility it is similar to Houston black clay.

HOUSTON-HUNT CLAY

Houston-Hunt clay represents a condition in which two soils are so intimately associated that no practicable separation can be made. Its occurrence is confined largely to the northern half of the watershed. This soil condition where mapped by the Bureau of Chemistry and Soils in cooperation with the Texas Agricultural Experiment Station before 1937 was included with the Houston black clay.

This complex may be recognized by a striped appearance in bare, cultivated fields. Land of this soil complex is generally termed "mixed land" by the natives. The stripes are alternately dark and light and extend down the slopes from the ridge tops normal to the contour. On virgin areas, like the Houston black clay, the surface is uneven, consisting of alternate ridges and depressions. These are shown in plate 2, *F*. The depressions define the location of the dark-colored soil. Nearly flat areas exhibit a similar mixed condition except that instead of occurring as stripes the dark-colored areas are circular, presenting a series of oval depressions. The character of these depressions is the same as shown in plate 2, *E*.

The light stripes occur on the crests of what appears to be a comb or wavelike formation of the parent material. The soil, although a clay, contains an appreciable quantity of very fine sand. The surface layer is a yellowish-brown calcareous granular clay grading into brownish-yellow calcareous clay or marl, the structure becoming more massive with depth. The change in color and structure is so gradual that there is no demarcation perceptible.

The dark stripes consist of dark-gray to nearly black noncalcareous clay to a depth of 2 to 3 feet where they become slightly calcareous and increasingly so with depth. The soil is plastic when wet but breaks down into fine granules upon drying when cultivated under proper moisture conditions. The color and texture continue uniform to depths as great as 6 feet. The line between the dark-colored material and the adjoining light-colored material is sinuous and rather sharp.

The underlying stratum is marl similar to that under the Houston black clay but differs in that it has a higher sand and a lower calcium-carbonate content. The upper boundary of the partially weathered or decayed marl is comblike or sinuous, whereas that of the unweathered or slightly weathered marl is more nearly parallel to the ground surface occurring at a depth of 3 to 6 feet. In the narrow transitional zone between are numerous calcium-carbonate concretions and deposits of soft, precipitated calcium carbonate. The structure in the unweathered marl is conchoidal and more massive than that of the overlying decayed marl. It also is free from concretions and precipitated calcium carbonate except as they may occur in veins or cracks constituting passageways for water percolating to lower levels. The juncture between the decayed marl and the unweathered marl is the only place in the profile that has any constancy and that is readily recognizable; consequently the depth classification is based on the distance to the unweathered marl. Occasional rounded quartzite pebbles are generally present throughout the solum and in the upper part of the substratum.

The relief is gently rolling, slopes ranging from 0 to 6 percent. The topographic features are much the same as those of Houston black clay areas except that the average slope is somewhat greater.

The permeability of the Houston-Hunt clay, like that of the Houston black clay, varies widely with the soil-moisture content. Surface drainage is rapid and internal drainage, although slow, is probably better than in the Houston black clay. It is equally erodible and somewhat more subject to erosion owing to its slightly greater average slope. Utilization under cultivation is the same as that of the Houston black clay. It is somewhat less productive, producing smaller yields of corn, especially in dry seasons.

Along its northwest borders the Houston-Hunt clay occurs in association with and adjacent to the Crockett clay loam and fine sandy loam, and along its southeast borders with the Houston black clay.

HOUSTON BLACK CLAY, SALINE PHASE

A number of small areas within areas of Houston black clay contain toxic concentrations of salts. These areas have a thin, white, salt incrustation on the surface when the soil remains undisturbed after a period of wet weather. The soil in these areas, unlike Houston black clay, contains little or no carbonate. In other respects the profile is similar to that of Houston black clay.

Plant growth in these areas is depressed. These saline areas occur at the base of relatively long slopes and it appears that underground seepage coming to the surface is responsible for their development.

HOUSTON BLACK CLAY, SHALLOW PHASE

The Houston black clay, shallow phase, occupies about one-tenth as much area as the Houston black clay. It is confined largely to the southwestern third of the watershed, being most extensive in the vicinity of the Government land.

The surface layer, to a depth of 10 to 15 inches, consists of a dark-gray calcareous clay grading to a dull brownish-gray calcareous friable clay, which becomes slightly lighter in color with depth. This material grades into a faintly yellowish-brown granular clay containing a few soft, white calcium carbonate concretions at about 3 feet. Shell fragments and a few isolated rounded quartzite pebbles are present throughout the profile. Under native grass cover roots were present throughout the profile to depths of 6 feet or more, decreasing in number with depth. After periods of wet weather, more wet spots or seeps occur on this soil type than on most other types. The seeps are usually at the base of the slope.

In addition to the shallower depth, Houston black clay, shallow phase, differs from Houston black clay mainly in that the lower soil layers and underlying substratum are more friable. It occurs on somewhat steeper topography, thus allowing more rapid surface drainage, and consequently is subject to more serious erosion, especially under cultivation. The percentage of this soil under cultivation is somewhat less than of the Houston black clay, and on many farms makes up most of the land that is reserved in its natural state as a grass meadow or pasture. The principal crops produced on this soil, as on the Houston black clay, are cotton, corn, oats, and sorghum. Generally, it is more suited to the production of oats and less suited to the other three crops than is the Houston black clay.

HOUSTON BLACK CLAY, SHALLOW PHASE, OVER CHALK

Houston black clay, shallow phase, over chalk, is confined to a relatively narrow band extending diagonally across the watershed and is the outcrop of a geologic material that corresponds

to at least a part of the Pecan Gap chalk. The extent to which this soil was separated was arbitrarily limited to areas in which the chalk occurred at depths of 6 feet or less. It is probable that the chalk is not the parent material of the soil in all areas where this type has been mapped, the soil probably having been developed from the marl overlying the chalk where the chalk occurs at considerable depth. Separation, however, seemed justified on the basis that ground-water conditions associated with these areas were markedly different from the surrounding territory. It is principally in the vicinity of this chalk outcrop that satisfactory wells can be obtained and that spring or seep areas are observed.

The surface layer, ranging from 12 to 24 inches in depth, is a dark-gray calcareous granular clay, becoming somewhat lighter with depth and in places becoming distinctly brownish-gray in the subsurface. This material may grade into a yellowish-brown calcareous granular clay of variable depth, but this yellowish-brown clay may be absent. Immediately below is a zone of light yellowish-brown weathered marl or chalk, which is extremely crumbly and porous and rests on a consolidated layer of medium-hard chalk, commonly containing numerous fractures. A few isolated quartzite pebbles commonly are present throughout the profile down to the chalk. Where the soil type retains the native vegetative cover grass roots are present throughout the material above the chalk, and at times they extend into the fractures and seams in the chalk below.

This soil occurs on the steepest slopes in the area. The steepness is unquestionably due to the underlying strata, the consolidated chalk having resisted erosion to a greater extent than the unconsolidated strata of marl that occur both above and below it. Because of the slope, surface drainage is rapid. Internal drainage also is rapid. Under cultivation sheet erosion is severe.

Like the Houston black clay, shallow phase, this soil is utilized with adjacent areas of Houston black clay but is better adapted to the production of oats and less adapted to the production of cotton, corn, and sorghum. It is not so extensively cultivated, however, owing to its greater slope and shallower soil.

AUSTIN CLAY, SHALLOW PHASE

The Austin clay, shallow phase, is confined to a few small areas associated with the Houston black clay, shallow phase, over chalk. It ranges from a few inches to a foot in depth. The surface soil in general is somewhat gray to decidedly gray when dry. It grades into a crumbly, chalky material that rests immediately on a relatively thin section of medium hard chalk. Much of this soil doubtless represents an eroded phase of the Houston black clay, shallow phase, over chalk. The soil is a brownish-gray, granular, and relatively more permeable than the soils of the Houston series.

It compares favorably with the soils in the Houston series in the production of oats, but yields of cotton and corn are very low. The small acreage in this type makes the separation of little importance. It is utilized with associated soil types.

CHALK OUTCROP

The few small areas in the watershed where the soil has been entirely removed by erosion exposing the slightly weathered chalk were mapped as chalk outcrop. In most of these areas the soil was very thin originally and was quickly washed away after the land was broken. These areas are on the steeper slopes. In wet years they may produce a fair yield of oats, but they are relatively unsuited for the production of other crops. The small acreage makes this separation of little importance.

WILSON CLAY

The dark-colored surface layer of Wilson clay ranges from 15 to more than 20 inches in depth. In color it varies from a dark gray or nearly black to a brownish gray. Although a clay, it contains a widely variable quantity of fine sand. This surface layer rests rather sharply on a dull-gray dense clay containing some fine sand but less than in the overlying material. At depths of 2 to 4 feet calcium-carbonate concretions are present and become very numerous with increasing depth. This dull-gray clay grades at a depth of about 6 feet to yellowish gray, calcareous clay containing soft, white deposits of calcium carbonate and numerous crystals of calcium sulphate. Hard, black, pelletlike, iron concretions are present throughout the profile to depths of about 8 feet, increasing in number with depth. Roots of trees and grass are present to depths of 7 feet.

When wet the dark-colored surface soil is exceedingly sticky and on drying breaks down into hard granules. Cultivation under proper moisture conditions produces a friable, loamy surface layer. Considerable care must be exercised to insure the soil being cultivated at its optimum moisture condition if this desirable state of tilth is to be obtained. Cultivation when the soil is slightly wetter or dryer results in the development of large, hard, persistent clods.

Like the Houston black clay the Wilson clay develops deep wide cracks as a result of prolonged dry periods. In this condition it is capable of absorbing large quantities of water rapidly. Heavy rains are necessary to produce run-off at such times.

WILSON CLAY LOAM

The Wilson clay loam differs from the Wilson clay chiefly in the texture of the surface soil, which is a dark-gray noncalcareous clay loam, ranging in depth from 10 to 15 inches. The surface soil rests rather sharply on a somewhat lighter gray noncalcareous clay. The latter contains occasional calcium carbonate concretions and is faintly mottled, the mottling increasing with depth. At from 30 to 36 inches this grades to a dense dull-gray clay, noncalcareous except for deposited calcium carbonate.

The quantity of deposited calcium carbonate increases with depth until at from 4 to 5 feet frequent lenses or seams of nearly pure calcium carbonate may be present. Iron concretions are present throughout the subsoil and substratum, becoming increasingly numerous to a depth that approaches the limits of appreciable weathering.

Like the Wilson clay, surface and internal drainage are poor and the soil is sticky when wet, cracks badly on drying, and has a narrow range of moisture conditions favorable to its cultivation.

WILSON FINE SANDY LOAM

The surface layer of Wilson fine sandy loam is a dull-gray fine sandy loam resting rather sharply at from 10 to 15 inches on a dark-gray, nearly black, plastic clay containing some fine sand and grading at about 2 feet into dull-gray slightly calcareous sandy clay containing a few large hard calcium carbonate concretions. The color becomes lighter with depth, and the calcium carbonate concretions become more numerous but smaller. A number of black, pelletlike, iron concretions are present below depths of 3 feet.

The surface soil has a tendency to crust upon drying. Cultivation, however, readily destroys this crust, developing a fine-grained loamy mass that is subject to slight wind erosion. Like the other types in the Wilson series, owing to its nearly flat topography and to the nature of the underlying material, both surface and internal drainage are slow. Land use is similar to

438239—42——4

that of other soil types in the series, and, while this type is a highly productive soil in general, it is a less productive soil than heavier textured types.

CROCKETT FINE SANDY LOAM

The surface soil of Crockett fine sandy loam is a brownish-gray fine sandy loam resting at from 10 to 14 inches on a darker brown clay loam. At a depth of about 20 inches it grades to an olive-gray clay containing a quantity of sand and in many places is mottled with red and yellow. The mottling may increase with depth, becoming pronounced at a depth ranging from 24 to 30 inches, then grading to a slightly mottled yellowish-gray clay. At about 3 feet this grades into a yellowish-gray calcareous sandy clay, mottled with yellow and gray and containing numerous hard calcium-carbonate concretions, soft white deposits of nearly pure calcium carbonate, and thin fragmentary lenses of sandstone. Under native vegetation tree and grass roots are present to depths of 3 feet.

The surface soil is highly permeable, taking up precipitation readily. On drying it tends to form a thin crust that is readily broken up by cultivation, resulting in a pulverized loamy surface.

CROCKETT CLAY LOAM

The Crockett clay loam differs from the Crockett fine sandy loam mainly in that the surface consists of a medium-brown clay that varies in depth from 4 to 8 inches.

Parts of the area designated as the Crockett clay loam are areas on which the original 10 to 15 inches of fine sandy loam has been removed by erosion.

Included with this soil type are many so-called slick spots that have relatively high concentration of alkali salts. These areas support little vegetation. They are small and scattered over the area and appear as sores on the land when under cultivation. Many are at the heads of small drainageways or gullies and are particularly subject to erosion. From the surface downward the soil is extremely dense and intractable.

HOUSTON-HUNT CLAY, COLLUVIAL PHASE

The Houston-Hunt clay, colluvial phase, is brownish gray and generally contains light-colored soil or decayed marl from the lower horizons of the Houston clay component of the complex. It was separated only where there was a quantity of recent deposition. Nearly all the lower slopes of this separation, however, have received depositions of soil material from the land above, adding to the elevation and fertility of the land on these lower slopes. The soil on which this colluvial material rests may be the Houston-Hunt clay, or in some areas the Wilson clay or clay loam.

WILSON CLAY, COLLUVIAL PHASE

Areas designated as Wilson clay, colluvial phase, are areas of Wilson clay or clay loam on which soil material from higher lying calcareous soils has been deposited.

The clay surface soil to a depth of from 6 to 12 or more inches is calcareous, the calcium carbonate content varying widely from place to place. Beneath the calcareous surface soil the profile is characteristic in all respects of the Wilson clay or clay loam.

WILSON CLAY LOAM, COLLUVIAL PHASE

Like the clay, the surface soil of the clay loam is calcareous. It consists of colluvial material contributed from the higher lying calcareous clay soil areas intermixed with sandy material from sandy upland soils. The colluvial clay loam material occurs over a normal Wilson clay or clay loam profile.

WILSON FINE SANDY LOAM, COLLUVIAL PHASE

The Wilson fine sandy loam, colluvial phase, differs from the clay and clay loam in that it is noncalcareous, having been transported largely from the noncalcareous sandy upland soils or ajacent areas of Wilson fine sandy loam. The color of this colluvial material is more brown and less gray than the normal Wilson fine sandy loam. The buried profile is normally that of a Wilson clay loam or fine sandy loam.

CROCKETT FINE SANDY LOAM, COLLUVIAL PHASE, AND CROCKETT CLAY LOAM, COLLUVIAL PHASE

The colluvial phases of Crockett fine sandy loam and clay loam are areas of these soils that have received deposition primarily of surface soil from the corresponding soil. Occasionally the deposition contains small amounts of calcareous material, doubtless material eroded from the calcareous substrata of the parent soil.

These colluvial phases in general are noticeably more productive than the soils from which they were derived and in eroded areas are about the only Crockett soils that are even moderately productive.

TRINITY CLAY

In some of the major subdrainages a very small acreage of alluvial material that originated in areas composed of dark-colored calcareous heavy-textured soils was separated as the Trinity clay.

The surface soil is a dark-gray, nearly black, granular clay, singularly uniform throughout, that grades at depths of about 2 feet to a material slightly lighter gray. The profile is calcareous throughout, usually containing shell fragments, calcium-carbonate concretions, and calcium-sulfate crystals in the subsurface.

CATALPA CLAY

Nearly all the alluvial soil mapped along the Brushy Creek drainageway has been classified as Catalpa clay. The surface soil is a brownish-gray clay grading to a grayer material at 1 to 2 feet. The material throughout the profile is extremely variable. Many lenses of sand are present. The profile is calcareous throughout. Included with this soil were a number of small areas of silty clay and clay loam that were not sufficiently large or well defined to justify their separation.

KAUFMAN FINE SANDY LOAM

The surface soil of Kaufman fine sandy loam is a light brownish-gray fine sandy loam which contains a small amount of organic matter and becomes slightly more gray with depth. The sandy material generally continues to depths of 3 feet or more and in many places is somewhat stratified, exhibiting lenses of coarser and finer materials. It is noncalcareous throughout and originated from material derived from upland sandy soils. Only one small area, on Brushy Creek near the headwaters, was mapped.

KAUFMAN CLAY

The surface soil of Kaufman clay is a dark-gray plastic clay. It is nearly black and extremely sticky when wet. Below depths of 2 to 3 feet it grades to a lighter dull gray, and in many places contains numerous calcium sulfate crystals and some calcium carbonate concretions.

As is true with all alluvial soils, it is extremely variable in its characteristics. It has developed from soil material contributed by the Houston-Hunt clay and soils of the Crockett series.

Only one small area in a tributary drainage basin in the northern part of the watershed was mapped as Kaufman clay. A number of other smaller areas that were included with the Wilson clay possibly could have been mapped as Kaufman clay.

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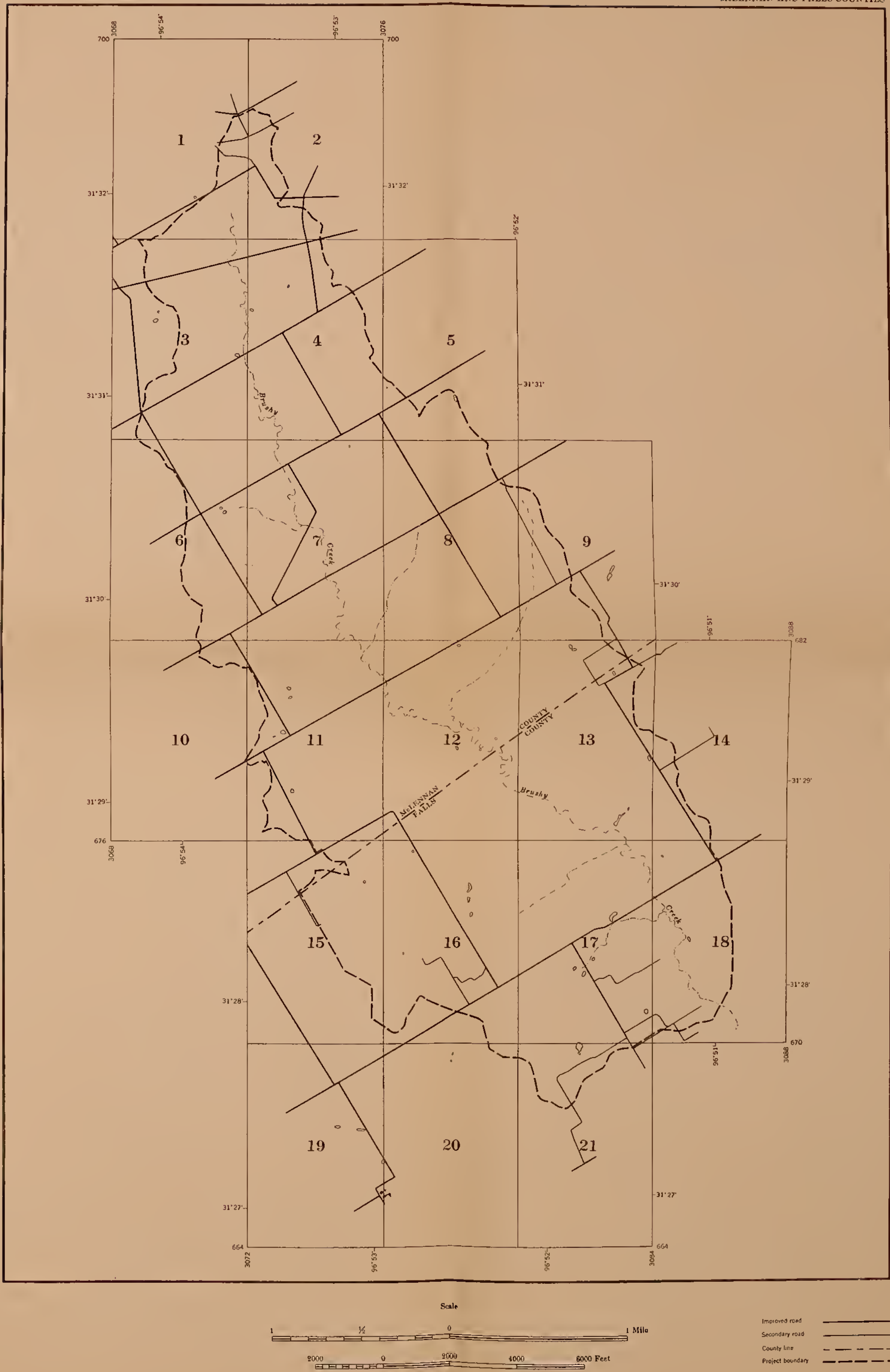
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

INDEX
BRUSHY CREEK WATERSHED
McLENNAN AND FALLS COUNTIES



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

McLENNAN COUNTY
Sheet No 1

Base map compiled from aerial photographs by Soil Conservation Service, 1941.
Surveys by Soil Conservation Service, 1938
Lambert projection. 2000 foot grid based upon Texas system (Central Zone) of plane coordinates with last three digits of grid numbers omitted.
Polyconic projection. North American 1927 datum indicated by marginal ticks.
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800
200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

1°45'57" S. W. corner of map
9½°
True North
Magnetic North
Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

3/B5

37 Moderate erosion 25 to [illegible] percent of topsoil removed and occasional gullies
B slope, [illegible] to [illegible] percent [illegible] Soil type Houston black clay shallow phase

EROSION

[illegible]

[illegible] than 25 percent of topsoil removed
25 to 75 percent of topsoil removed (on soil group [illegible] 25 to [illegible] percent of topsoil removed)
[illegible] 75 percent of topsoil removed (used only on soil group 2)
[illegible] percent or more [illegible] topsoil removed [illegible] subsoil and [illegible] subsoil removed
[illegible]

[illegible]

Erosion symbol	Approximate depth in inches to:		
	[illegible] material in soil group 1	1b	B horizon in soil group 2
	[illegible] or more	36 or more	12 or more
3	[illegible] to 60	12 to 36	8 to 12
33			4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1 PRAIRIE SOIL GRANULAR STRUCTURE, ALKALINE THROUGHOUT
- a Normal profile
  - 1 Houston black clay
  - 2 Houston black clay, gravelly phase
  - 3 Houston-Hunt clay
  - 4 Houston black clay, saline phase
- b Shallow to parent material
  - 5 Houston black clay, shallow phase
  - 6 Houston black clay, shallow phase over chalk
  - 7 Austin clay shallow phase
  - 8 Chalk outcrop

2 PRAIRIE SOIL MODERATELY CALCAREOUS SUBSTRATA
- a [illegible]
  - 9 Wilson clay
  - 10 Wilson clay [illegible]
  - Wilson fine sandy loam
- b Moderately [illegible]
  - 12 [illegible]
  - [illegible] sandy loam

3 COLLUVIAL SOIL
- 14 Houston-Hunt clay, colluvial phase
- 15 Wilson clay, colluvial phase
- 16 Wilson clay loam, colluvial phase
- [illegible] Wilson fine sandy loam, colluvial phase
- 18 [illegible] clay loam, colluvial phase
- [illegible] fine sandy loam, colluvial phase

4 ALLUVIAL SOIL
- 20 Trinity clay
- 21 Catalpa clay
- 22 Kaufman clay
- 23 Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads Dirt (good motor)

Dirt (poor motor or private)

Bridge

Culvert

Buildings

Church

School

Dams

DRAINAGE

Perennial streams

Intermittent streams

Ditches

Perennial lakes

Sinks

HYDROLOGIC

Gaging station

Runoff measuring station and silt box

Standard rain gage

Recording rain gage

Meteorological station

Standard rain gage and temperature station

Recording rain gage and temperature station

Recording rain gage, temperature and wind station

Nonrecording ground-water well

Recording ground-water well

Small watershed boundary

Watershed boundary

Project boundary

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS

BLACKLANDS
EXPERIMENTAL WATERSHED

McLENNAN COUNTY

Sheet No 2

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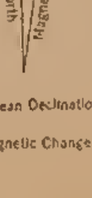
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment



Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

3785

37 · Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
8 · slope, 1 to 3 percent 5 · Soil type: Houston black clay, shallow phase

EROSION

SHEET EROSION
- 2 · Less than 25 percent of topsoil removed
- 3 · 25 to 75 percent of topsoil removed (on soil group 2, 25 to 50 percent of topsoil removed)
- 33 · 50 to 75 percent of topsoil removed (used only on soil group 2)
- 4 · 75 percent or more of topsoil removed, or all topsoil and some subsoil removed
- 5 · All topsoil and most or all of subsoil removed; parent material may be exposed or eroded

GULLY EROSION
- 7 · Occasional gullies: More than 100 feet apart
- 8 · Frequent gullies: Occurring less than 100 feet apart, but including less than 75 percent of area delineated
- 9 · Very frequent gullies
- ⌣ · Indicates gullies too deep to be crossed with tillage implements, as 7, 8, or 9
- + · Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
C	6 to 8
D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Approximate depth in inches to :

Erosion symbol	Parent material in soil group 1a	Parent material in soil group 1b	B horizon in soil group 2
2	60 or more	36 or more	12 or more
3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1 PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT
- a · Normal profile
  - 1 · Houston black clay
  - 2 · Houston black clay, gravelly phase
  - 3 · Houston-Hunt clay
  - 4 · Houston black clay, saline phase
- b · Shallow to parent material
  - 5 · Houston black clay, shallow phase
  - 6 · Houston black clay, shallow phase over chalk
  - 7 · Austin clay, shallow phase
  - 8 · Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA
- a · Dense on drying
  - 9 · Wilson clay
  - 10 · Wilson clay loam
  - 11 · Wilson fine sandy loam
- b · Moderately friable
  - 12 · Crockett clay loam
  - 13 · Crockett fine sandy loam

3-COLLUVIAL SOILS
- 14 · Houston-Hunt clay, colluvial phase
- 15 · Wilson clay, colluvial phase
- 16 · Wilson clay loam, colluvial phase
- 17 · Wilson fine sandy loam, colluvial phase
- 18 · Crockett clay loam, colluvial phase
- 19 · Crockett fine sandy loam, colluvial phase

4 ALLUVIAL SOILS
- 20 · Trinity clay
- 21 · Catalpa clay
- 22 · Kaufman clay
- 23 · Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads: Dirt (good motor)
Dirt (poor motor or private)
Bridge
Culvert
Buildings
Church
School
Dam

DRAINAGE

Perennial streams
Intermittent streams
Ditches
Perennial lake
Sinks

HYDROLOGIC

Gaging station
Runoff measuring station and silt box
Standard rain gage
Recording rain gage
Meteorological station
Standard rain gage and temperature station
Recording rain gage and temperature station
Recording rain gage, temperature and wind station
Nonrecording ground-water well
Recording ground-water well
Small watershed boundary
Watershed boundary
Project boundary

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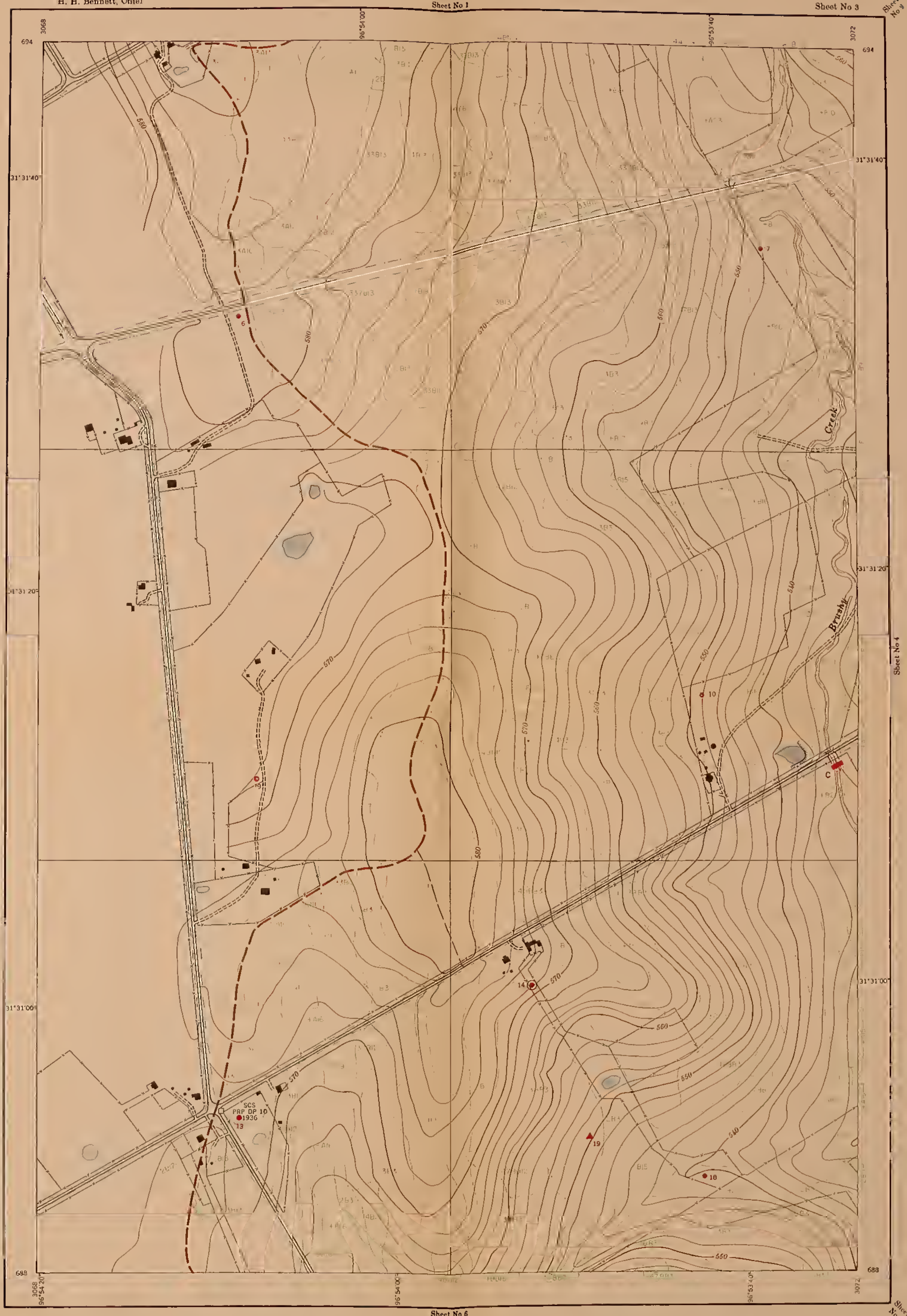
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

McLENNAN COUNTY
Sheet No 3



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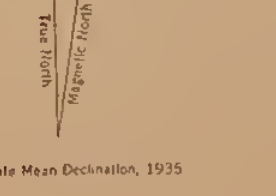
Hydrologic Division Research C. E. Ramser, Chief

Scale 1:4,800

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment



Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

BLACKLANDS EXPERIMENTAL WATERSHED

Sheet No. 3

LEGEND

EXPLANATION OF SYMBOL

3785

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
B - slope, 1 to 3 percent 5 - Soil type, Houston black clay, shallow phase

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GULLY EROSION

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+ - Recent deposits

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- Recording ground-water well
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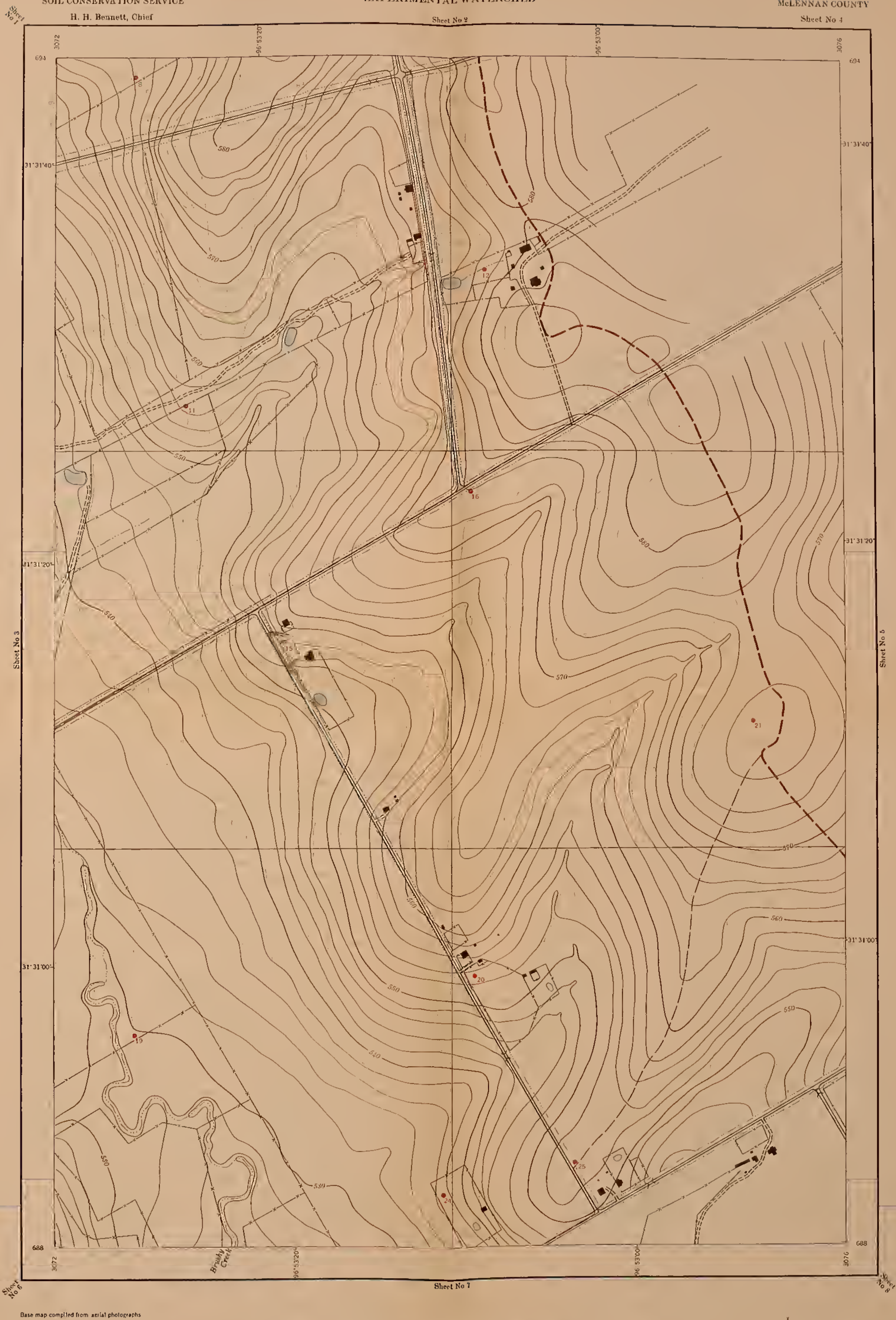
- Watershed boundary
- Project boundary

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS

BLACKLANDS
EXPERIMENTAL WATERSHED

McLENNAN COUNTY



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Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

1°46'20" S. W. corner of map
9½°
True North
Magnetic North

Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

BLACKLANDS EXPERIMENTAL WATERSHED

Sheet No. 4

LEGEND

EXPLANATION OF SYMBOL

37B5

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+ - Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
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D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Erosion symbol	Approximate depth in inches to: Parent material in soil group 1a	1b	B horizon in soil group 2
2	60 or more	36 or more	12 or more
3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT
- a - Normal profile
  - 1 - Houston black clay
  - 2 - Houston black clay, gravelly phase
  - 3 - Houston-Hunt clay
  - 4 - Houston black clay, saline phase
- b - Shallow to parent material
  - 5 - Houston black clay, shallow phase
  - 6 - Houston black clay, shallow phase over chalk
  - 7 - Austin clay, shallow phase
  - 8 - Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA
- a - Dense on drying
  - 9 - Wilson clay
  - 10 - Wilson clay loam
  - 11 - Wilson fine sandy loam
- b - Moderately friable
  - 12 - Crockett clay loam
  - 13 - Crockett fine sandy loam

3-COLLUVIAL SOILS
- 14 - Houston-Hunt clay, colluvial phase
- 15 - Wilson clay, colluvial phase
- 16 - Wilson clay loam, colluvial phase
- 17 - Wilson fine sandy loam, colluvial phase
- 18 - Crockett clay loam, colluvial phase
- 19 - Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS
- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

TOPOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads: Dirt (good motor)
Dirt (poor motor or private)
Bridge
Culvert
Buildings
Church School
Dams

DRAINAGE

Perennial streams
Intermittent streams
Ditches
Perennial lakes
Sinks

HYDROLOGIC

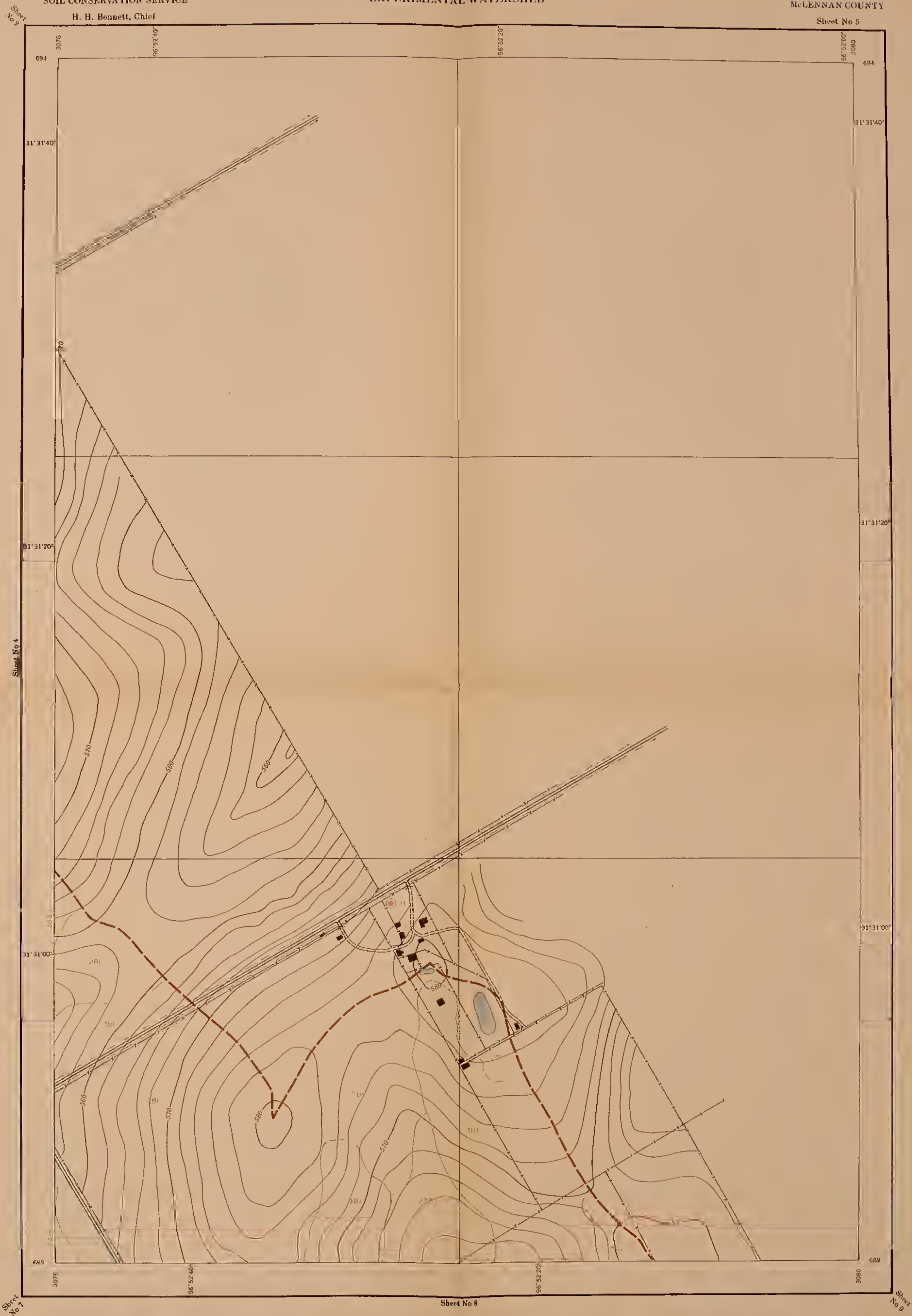
Gaging station
Runoff measuring station and silt box
Standard rain gage
Recording rain gage
Meteorological station
Standard rain gage and temperature station
Recording rain gage and temperature station
Recording rain gage, temperature and wind station
Nonrecording ground-water well
Recording ground-water well
Small watershed boundary
Watershed boundary
Project boundary

TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

BLACKLANDS
EXPERIMENTAL WATERSHED

McLENNAN COUNTY

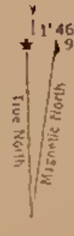


Base map compiled from aerial photographs by Soil Conservation Service, 1941.
Surveys by Soil Conservation Service, 1938.
Lambert projection. 2000 foot grid based upon Texas system (Central Zone) of plane coordinates with last three digits of grid numbers omitted.
Polyconic projection. North American 1927 datum indicated by marginal ticks.
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment



Approximate Mean Declination, 19. 5
Annual Magnetic Change 2 E

LEGEND

EXPLANATION OF SYMBOL

3785

37 · Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
B · slope, 1 to 3 percent   5 · Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION

2 · Less than 25 percent of topsoil removed
3 · 25 to 75 percent of topsoil removed (on soil group 2, 25 to 50 percent of topsoil removed)
33 · 50 to 75 percent of topsoil removed (used only on soil group 2)
4 · 75 percent or more of topsoil removed, or all topsoil and some subsoil removed
5 · All topsoil and most or all of subsoil removed; parent material may be exposed or eroded

GULLY EROSION

7 · Occasional gullies: More than 100 feet apart
8 · Frequent gullies: Occurring less than 100 feet apart, but including less than 75 percent of area delineated
9 · Very frequent gullies
‿ · Indicates gullies too deep to be crossed with tillage implements, as 7, 8, or 9

\+ · Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
C	6 to 8
D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Approximate depth in inches to :

Erosion symbol	Parent material in soil group 1a	Parent material in soil group 1b	B horizon in soil group 2
2	60 or more	36 or more	12 or more
3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT

a · Normal profile
- 1 · Houston black clay
- 2 · Houston black clay, gravelly phase
- 3 · Houston-Hunt clay
- 4 · Houston black clay, saline phase

b · Shallow to parent material
- 5 · Houston black clay, shallow phase
- 6 · Houston black clay, shallow phase over chalk
- 7 · Austin clay, shallow phase
- 8 · Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA

a · Dense on drying
- 9 · Wilson clay
- 10 · Wilson clay loam
- 11 · Wilson fine sandy loam

b · Moderately friable
- 12 · Crockett clay loam
- 13 · Crockett fine sandy loam

3-COLLUVIAL SOILS
- 14 · Houston-Hunt clay, colluvial phase
- 15 · Wilson clay, colluvial phase
- 16 · Wilson clay loam, colluvial phase
- 17 · Wilson fine sandy loam, colluvial phase
- 18 · Crockett clay loam, colluvial phase
- 19 · Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS
- 20 · Trinity clay
- 21 · Catalpa clay
- 22 · Kaufman clay
- 23 · Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

- Roads · Dirt (good motor)
- Dirt (poor motor or private)
- Bridge
- Culvert
- Buildings
- Church
- School
- Dams

DRAINAGE

- Perennial streams
- Intermittent streams
- Ditches
- Perennial lakes
- Sinks

- Gaging station
- Runoff measuring station and silt box
- Standard rain gage
- Recording rain gage
- Meteorological station
- Standard rain gage and temperature station

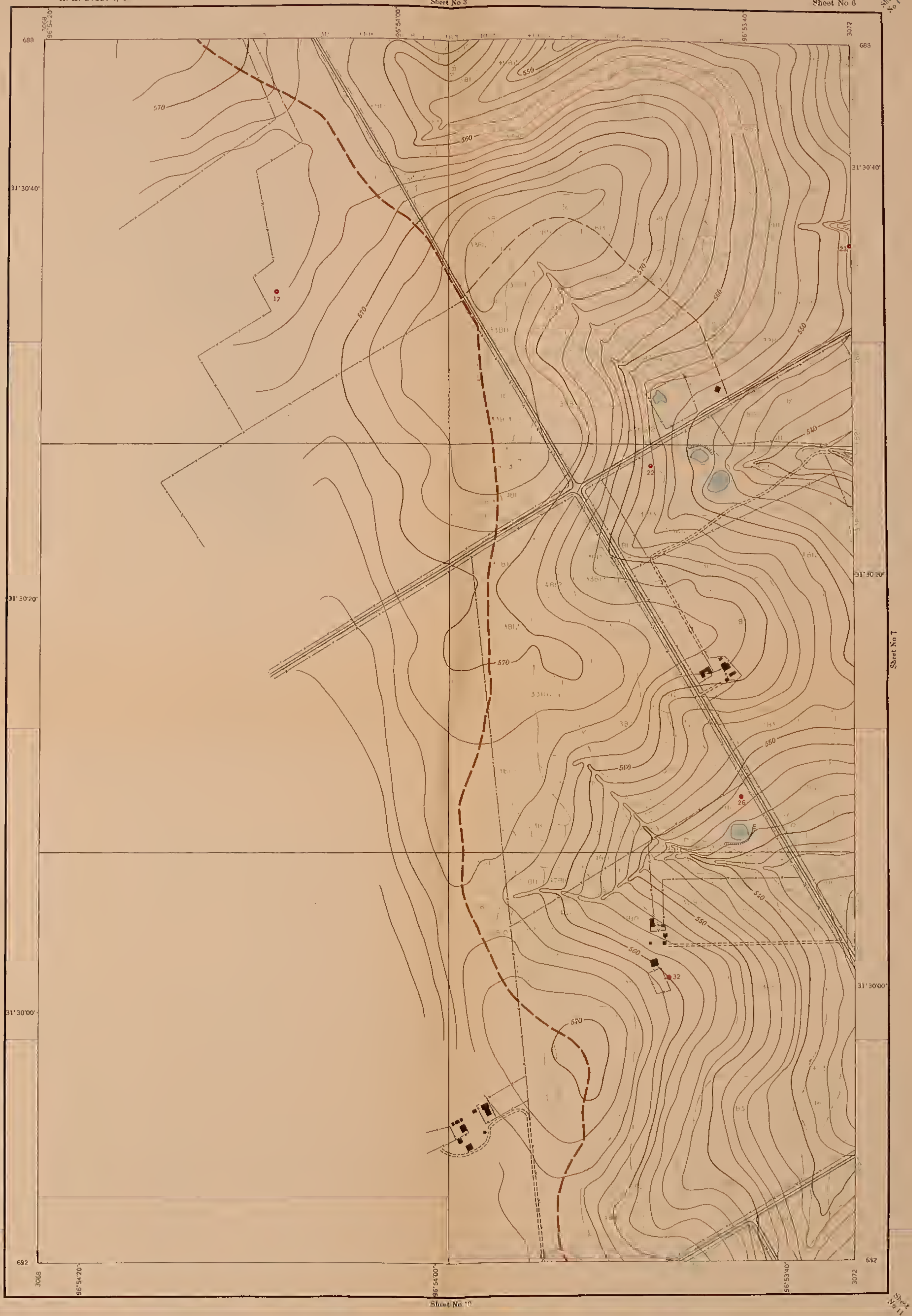
HYDROLOGIC

- Recording rain gage and temperature station
- Recording rain gage, temperature and wind station
- Nonrecording ground-water well
- Recording ground-water well
- Small watershed boundary
- Watershed boundary
- Project boundary

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

McLENNAN COUNTY



Base map compiled from aerial photographs by Soil Conservation Service, 1941.
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Lambert projection 2000 foot grid based upon Texas system (Central Zone) of plane coordinates with last three digits of grid numbers omitted.
Polyconic projection North American 1927 datum indicated by marginal ticks
Hydrologic Division Research C. E. Ramser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

1°45'55" S. W. corner of map
91'
True North
Magnetic North

Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

3785

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies

8 - slope, 1 to 3 percent 5 Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION

- 2 - Less than 25 percent of topsoil removed
- 3 - 25 to 75 percent of topsoil removed (on soil group 2, 25 to 50 percent of topsoil removed)
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- 4 - 75 percent or more of topsoil removed, or all topsoil and some subsoil removed
- 5 - All topsoil and most or all of subsoil removed; parent material may be exposed or eroded

GULLY EROSION

- 7 - Occasional gullies: More than 100 feet apart
- 8 - Frequent gullies: Occurring less than 100 feet apart, but including less than 75 percent of area delineated
- 9 - Very frequent gullies
- ⌒ - Indicates gullies too deep to be crossed with tillage implements, as $\widehat{7}$, $\widehat{8}$, or $\widehat{9}$

+ - Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
C	6 to 8
D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Approximate depth in inches to:

Erosion symbol	Parent material in soil group 1a	Parent material in soil group 1b	B horizon in soil group 2
2	60 or more	36 or more	12 or more
3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT

- a - Normal profile
  - 1 - Houston black clay
  - 2 - Houston black clay, gravelly phase
  - 3 - Houston Hunt clay
  - 4 - Houston black clay saline phase
- b - Shallow to parent material
  - 5 - Houston black clay, shallow phase
  - 6 - Houston black clay, shallow phase over chalk
  - 7 - Austin clay, shallow phase
  - 8 - Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA

- a - Dense on drying
  - 9 - Wilson clay
  - 10 - Wilson clay loam
  - 11 - Wilson fine sandy loam
- b - Moderately friable
  - 12 - Crockett clay loam
  - 13 - Crockett fine sandy loam

3-COLLUVIAL SOILS

- 14 - Houston-Hunt clay, colluvial phase
- 15 - Wilson clay, colluvial phase
- 16 - Wilson clay loam, colluvial phase
- 17 - Wilson fine sandy loam, colluvial phase
- 18 - Crockett clay loam, colluvial phase
- 19 - Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS

- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

- Roads - Dirt (good motor)
- Dirt (poor motor or private)
- Bridge
- Culvert
- Buildings
- Church
- School
- Dams

DRAINAGE

- Perennial streams
- Intermittent streams
- Ditches
- Perennial lakes
- Sinks

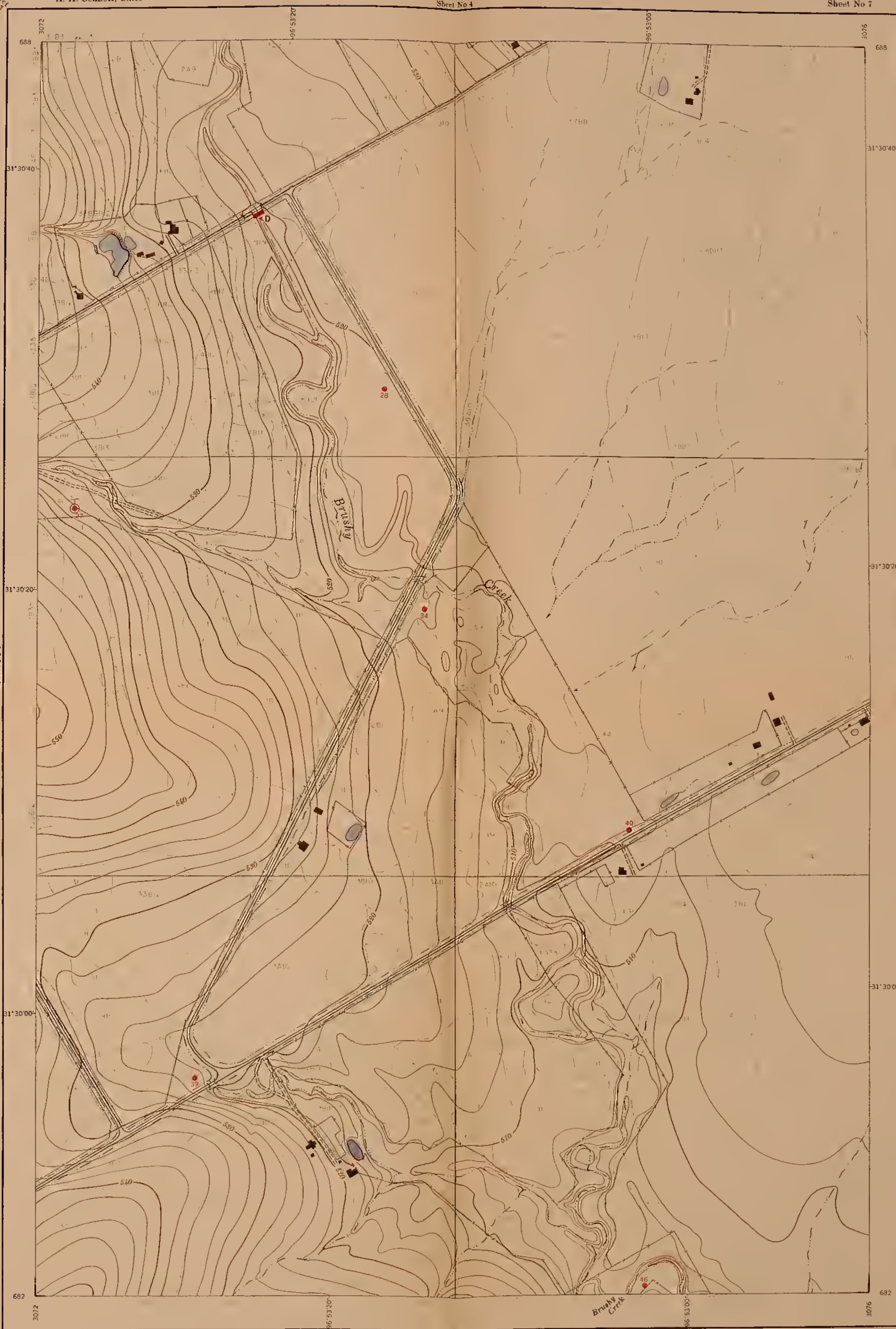
HYDROLOGIC

- Gaging station
- Runoff measuring station and silt box
- Standard rain gage
- Recording rain gage
- Meteorological station
- Standard rain gage and temperature station
- Recording rain gage and temperature station
- Recording rain gage, temperature and wind station
- Nonrecording ground-water well
- Recording ground-water well
- Small watershed boundary
- Watershed boundary
- Project boundary

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

McLENNAN COUNTY
Sheet No 7



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Polyconic projection. North American 1927 datum indicated by marginal ticks.
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800
200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

Y
1°46'19" S. W. corner of map
91°
True North
Magnetic North
Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

3785

37 · Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies

B · slope, 1 to 3 percent 5 · Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION
- 2 · Less than 25 percent of topsoil removed
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- 7 · Occasional gullies: More than 100 feet apart
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- ⌒ · Indicates gullies too deep to be crossed with tillage implements, as $\widehat{7}$, $\widehat{8}$, or $\widehat{9}$

+ · Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
C	6 to 8
D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Approximate depth in inches to :

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4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT
- a · Normal profile
  - 1 · Houston black clay
  - 2 · Houston black clay, gravelly phase
  - 3 · Houston-Hunt clay
  - 4 · Houston black clay, saline phase
- b · Shallow to parent material
  - 5 · Houston black clay, shallow phase
  - 6 · Houston black clay, shallow phase over chalk
  - 7 · Austin clay, shallow phase
  - 8 · Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA
- a · Dense on drying
  - 9 · Wilson clay
  - 10 · Wilson clay loam
  - 11 · Wilson fine sandy loam
- b · Moderately friable
  - 12 · Crockett clay loam
  - 13 · Crockett fine sandy loam

3-COLLUVIAL SOILS
- 14 · Houston-Hunt clay, colluvial phase
- 15 · Wilson clay, colluvial phase
- 16 · Wilson clay loam, colluvial phase
- 17 · Wilson fine sandy loam, colluvial phase
- 18 · Crockett clay loam, colluvial phase
- 19 · Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS
- 20 · Trinity clay
- 21 · Catalpa clay
- 22 · Kaufman clay
- 23 · Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads · Dirt (good motor)

Dirt (poor motor or private)

Bridge

Culvert

Buildings

Church

School

Dams

DRAINAGE

Perennial streams

Intermittent streams

Ditches

Perennial lakes

Sinks

HYDROLOGIC

Gaging station

Runoff measuring station and silt box

Standard rain gage

Recording rain gage

Meteorological station

Standard rain gage and temperature station

Recording rain gage and temperature station

Recording rain gage, temperature and wind station

Nonrecording ground-water well

Recording ground-water well

Small watershed boundary

Watershed boundary

Project boundary

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

McLENNAN COUNTY
Sheet No 8

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Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

1°46'43" S. W. corner of map
94'
True North
Magnetic North

Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

37B5

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
B - slope, 1 to 3 percent   5 - Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION
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- 3 - 25 to 75 percent of topsoil removed (on soil group 2, 25 to 50 percent of topsoil removed)
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GULLY EROSION
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- 9 - Very frequent gullies
- ◡ - Indicates gullies too deep to be crossed with tillage implements, as 7, 8, or 9

+ - Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
C	6 to 8
D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Approximate depth in inches to :

Erosion symbol	Parent material in soil group 1a	Parent material in soil group 1b	B horizon in soil group 2
2	60 or more	36 or more	12 or more
3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT
- a - Normal profile
  - 1 - Houston black clay
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  - 3 - Houston-Hunt clay
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  - 7 - Austin clay, shallow phase
  - 8 - Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA
- a - Dense on drying
  - 9 - Wilson clay
  - 10 - Wilson clay loam
  - 11 - Wilson fine sandy loam
- b - Moderately friable
  - 12 - Crockett clay loam
  - 13 - Crockett fine sandy loam

3-COLLUVIAL SOILS
- 14 - Houston-Hunt clay, colluvial phase
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- 17 - Wilson fine sandy loam, colluvial phase
- 18 - Crockett clay loam, colluvial phase
- 19 - Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS
- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

- Roads - Dirt (good motor)
- Dirt (poor motor or private)
- Bridge
- Culvert
- Buildings
- Church
- School
- Dams

DRAINAGE

- Perennial streams
- Intermittent streams
- Ditches
- Perennial lakes
- Sinks

HYDROLOGIC

- Gaging station
- Runoff measuring station and silt box
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- Recording rain gage
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- Standard rain gage and temperature station
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- Small watershed boundary
- Watershed boundary
- Project boundary

TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

BLACKLANDS
EXPERIMENTAL WATERSHED

McLENNAN AND FALLS COUNTIES

Base map compiled from aerial photographs
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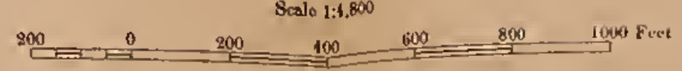
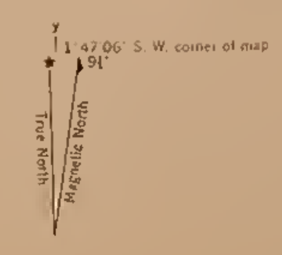
Polyconic projection. North American 1927 datum
indicated by marginal ticks.
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800



Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment



Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

BLACKLANDS EXPERIMENTAL WATERSHED

Sheet No. 9

LEGEND

EXPLANATION OF SYMBOL

3785

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies

8 - slope, 1 to 3 percent   5 - Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION

- 2 - Less than 25 percent of topsoil removed
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+ - Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
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SOILS

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- a - Normal profile
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  - 8 - Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA

- a - Dense on drying
  - 9 - Wilson clay
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  - 11 - Wilson fine sandy loam
- b - Moderately friable
  - 12 - Crockett clay loam
  - 13 - Crockett fine sandy loam

3-COLLUVIAL SOILS

- 14 - Houston-Hunt clay, colluvial phase
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- 17 - Wilson fine sandy loam, colluvial phase
- 18 - Crockett clay loam, colluvial phase
- 19 - Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS

- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads - Dirt (good motor)

Dirt (poor motor or private)

Bridge

Culvert

Buildings

Church

School

Dams

DRAINAGE

Perennial streams

Intermittent streams

Ditches

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Runoff measuring station and silt box

Standard rain gage

Recording rain gage

Meteorological station

Standard rain gage and temperature station

Recording rain gage and temperature station

Recording rain gage, temperature and wind station

Nonrecording ground-water well

Recording ground-water well

Small watershed boundary

Watershed boundary

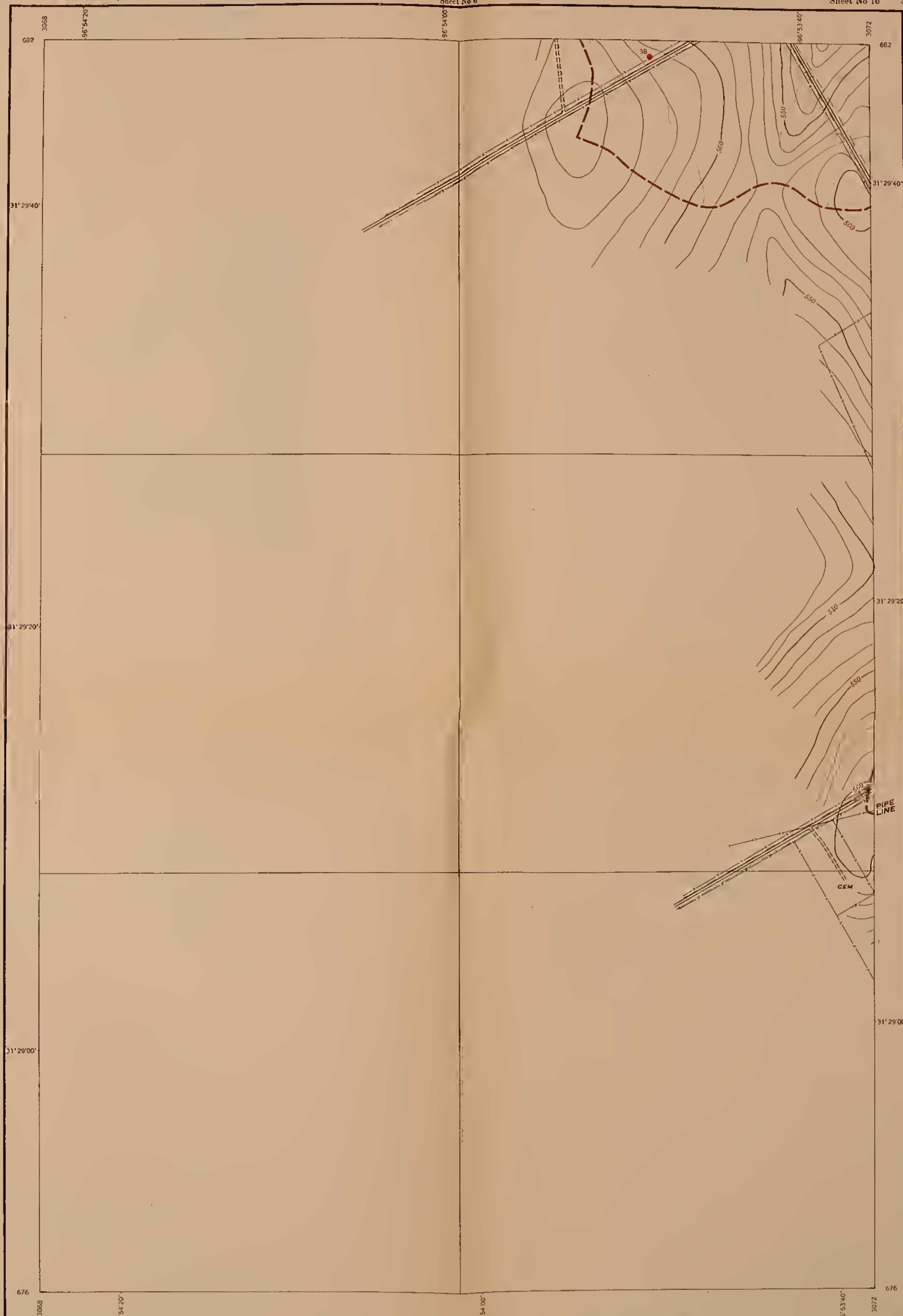
Project boundary

TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

BLACKLANDS
EXPERIMENTAL WATERSHED

McLENNAN COUNTY



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Polyconic projection. North American 1927 datum
indicated by marginal ticks.
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

True North
Magnetic North
Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

3785

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
B - slope, 1 to 3 percent 5 - Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION
- 2 - Less than 25 percent of topsoil removed
- 3 - 25 to 75 percent of topsoil removed (on soil group 2, 25 to 50 percent of topsoil removed)
- 33 - 50 to 75 percent of topsoil removed (used only on soil group 2)
- 4 - 75 percent or more of topsoil removed, or all topsoil and some subsoil removed
- 5 - All topsoil and most or all of subsoil removed; parent material may be exposed or eroded

GULLY EROSION
- 7 - Occasional gullies: More than 100 feet apart
- 8 - Frequent gullies: Occurring less than 100 feet apart, but including less than 75 percent of area delineated
- 9 - Very frequent gullies
- ⌒ - Indicates gullies too deep to be crossed with tillage implements, as 7, 8, or 9

+ - Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
C	6 to 8
D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Erosion symbol	Approximate depth in inches to: Parent material in soil group 1a	1b	B horizon in soil group 2
2	60 or more	36 or more	12 or more
3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT
- a - Normal profile
  - 1 - Houston black clay
  - 2 - Houston black clay, gravelly phase
  - 3 - Houston-Hunt clay
  - 4 - Houston black clay, saline phase
- b - Shallow to parent material
  - 5 - Houston black clay, shallow phase
  - 6 - Houston black clay, shallow phase over chalk
  - 7 - Austin clay, shallow phase
  - 8 - Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA
- a - Dense on drying
  - 9 - Wilson clay
  - 10 - Wilson clay loam
  - 11 - Wilson fine sandy loam
- b - Moderately friable
  - 12 - Crockett clay loam
  - 13 - Crockett fine sandy loam

3-COLLUVIAL SOILS
- 14 - Houston-Hunt clay, colluvial phase
- 15 - Wilson clay, colluvial phase
- 16 - Wilson clay loam, colluvial phase
- 17 - Wilson fine sandy loam, colluvial phase
- 18 - Crockett clay loam, colluvial phase
- 19 - Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS
- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads - Dirt (good motor)

Dirt (poor motor or private)

Bridge

Culvert

Buildings

Church School

Dams

DRAINAGE

Perennial streams

Intermittent streams

Ditches

Perennial lakes

Sinks

HYDROLOGIC

Gaging station

Runoff measuring station and silt box

Standard rain gage

Recording rain gage

Meteorological station

Standard rain gage and temperature station

Recording rain gage and temperature station

Recording rain gage, temperature and wind station

Nonrecording ground-water well

Recording ground-water well

Small watershed boundary

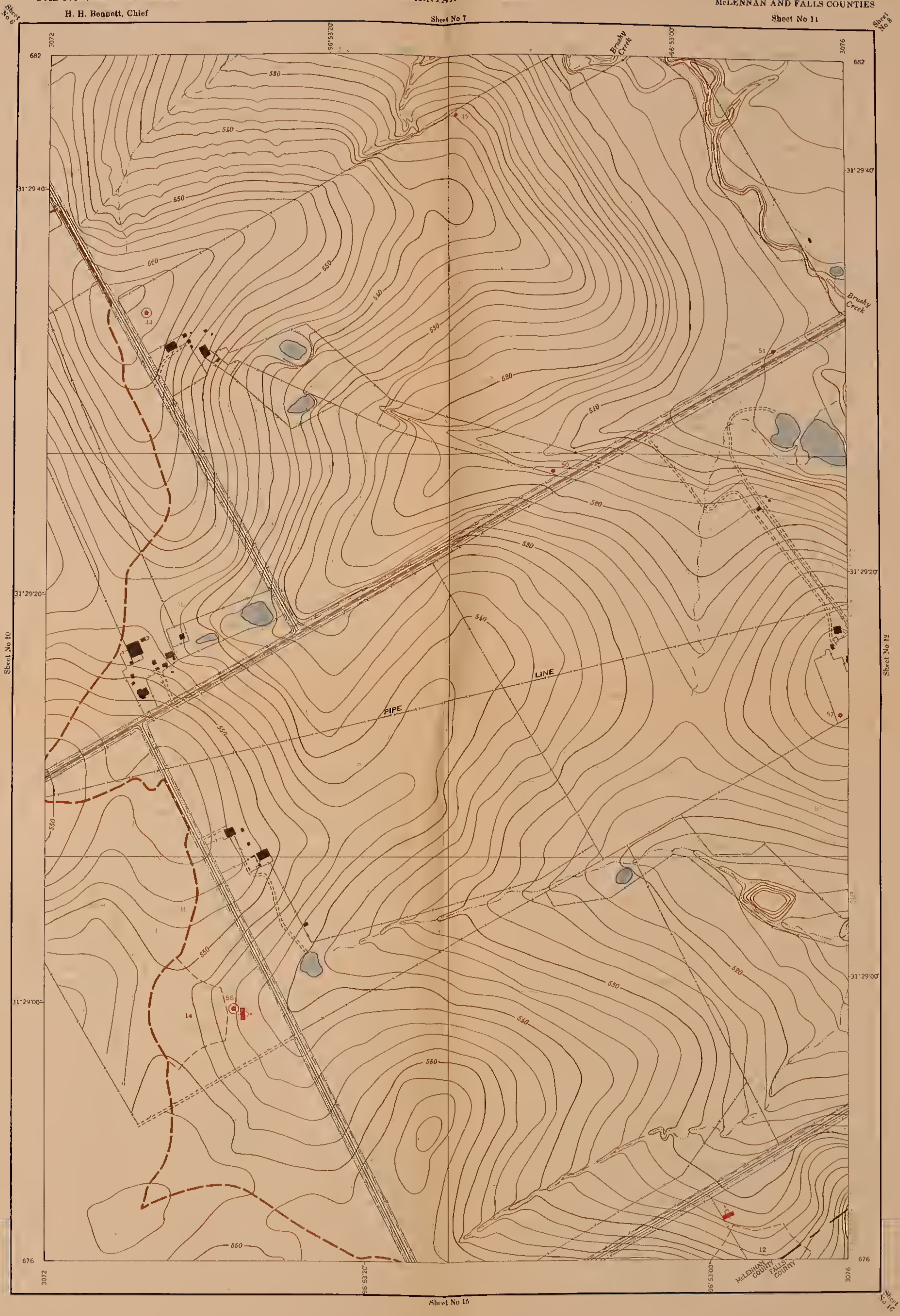
Watershed boundary

Project boundary

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

McLENNAN AND FALLS COUNTIES



Base map compiled from aerial photographs by Soil Conservation Service, 1941.
Surveys by Soil Conservation Service, 1938.
Lambert projection. 2000 foot grid based upon Texas system (Central Zone) of plane coordinates with last three digits of grid numbers omitted.
Polyconic projection. North American 1927 datum indicated by marginal ticks.
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

BLACKLANDS EXPERIMENTAL WATERSHED

Sheet No. 11

LEGEND

EXPLANATION OF SYMBOL

3785

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
8 - slope, 1 to 3 percent   5 - Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION
- 2 - Less than 25 percent of topsoil removed
- 3 - 25 to 75 percent of topsoil removed (on soil group 2, 25 to 50 percent of topsoil removed)
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GULLY EROSION
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- 9 - Very frequent gullies
- ⌒ - Indicates gullies too deep to be crossed with tillage implements, as 7̑, 8̑, or 9̑

+ - Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
C	6 to 8
D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Approximate depth in inches to :

Erosion symbol	Parent material in soil group 1a	Parent material in soil group 1b	B horizon in soil group 2
2	60 or more	36 or more	12 or more
3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT
- a Normal profile
  - 1 - Houston black clay
  - 2 - Houston black clay, gravelly phase
  - 3 - Houston-Hunt clay
  - 4 - Houston black clay, saline phase
- b - Shallow to parent material
  - 5 - Houston black clay, shallow phase
  - 6 - Houston black clay, shallow phase over chalk
  - 7 - Austin clay, shallow phase
  - 8 - Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA
- a - Dense on drying
  - 9 - Wilson clay
  - 10 - Wilson clay loam
  - 11 - Wilson fine sandy loam
- b - Moderately triable
  - 12 - Crockett clay loam
  - 13 - Crockett fine sandy loam

3-COLLUVIAL SOILS
- 14 - Houston-Hunt clay, colluvial phase
- 15 - Wilson clay, colluvial phase
- 16 - Wilson clay loam, colluvial phase
- 17 - Wilson fine sandy loam, colluvial phase
- 18 - Crockett clay loam, colluvial phase
- 19 - Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS
- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads - Dirt (good motor)

Dirt (poor motor or private)

Bridge

Culvert

Buildings

Church   School

Dams

DRAINAGE

Perennial streams

Intermittent streams

Ditches

Perennial lakes

Sinks

HYDROLOGIC

Gaging station

Runoff measuring station and silt box

Standard rain gage

Recording rain gage

Meteorological station

Standard rain gage and temperature station

Recording rain gage and temperature station

Recording rain gage, temperature and wind station

Nonrecording ground-water well

Recording ground-water well

Small watershed boundary

Watershed boundary

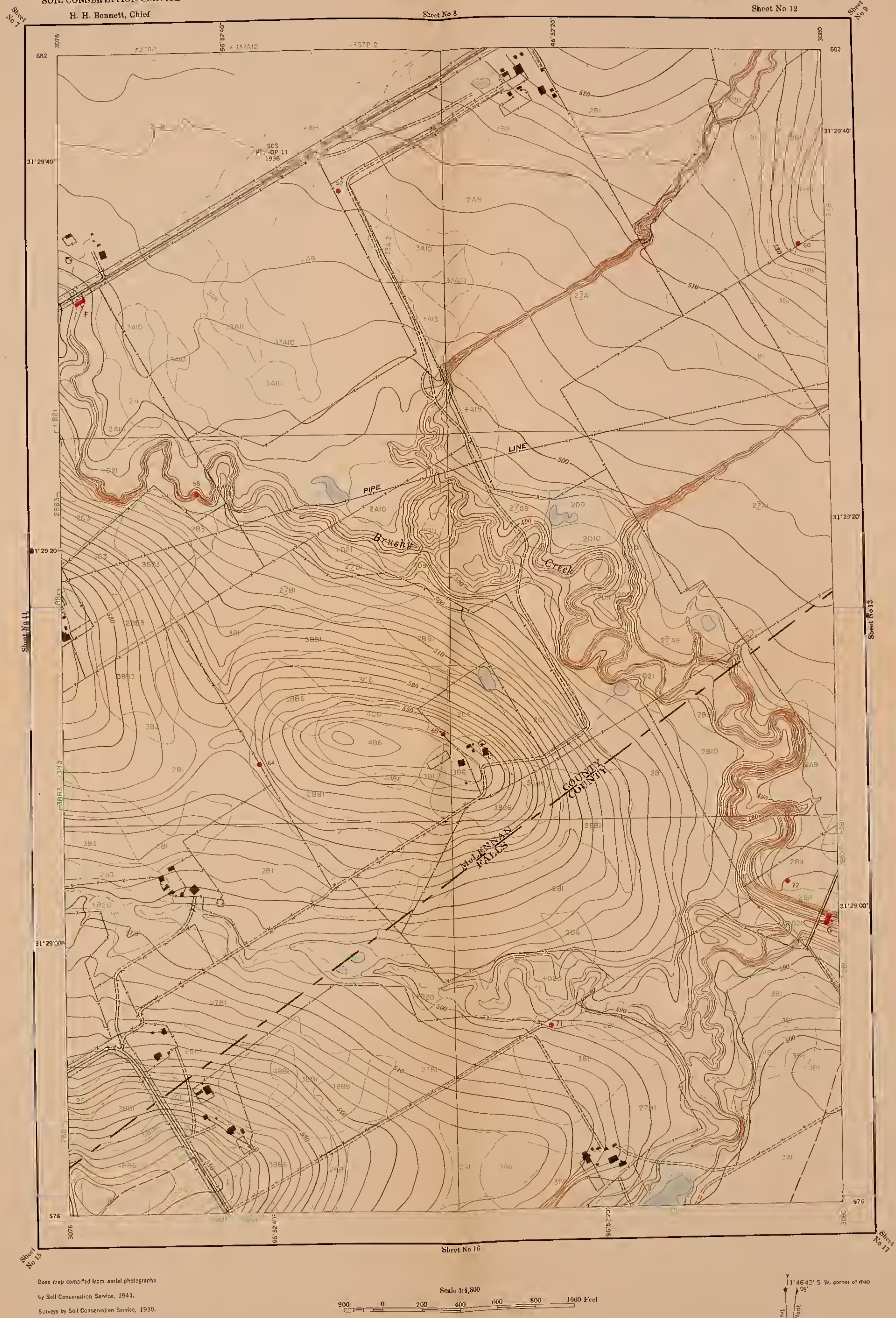
Project boundary

TEXAS

BLACKLANDS
EXPERIMENTAL WATERSHED

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

McLENNAN AND FALLS COUNTIES



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Polyconic projection. North American 1927 datum indicated by marginal ticks.
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

11°46'42" S. W. corner of map
True North
Magnetic North
Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

3785

Moderate ... percent of topsoil removed and occasional gullies
B slope, 1 to 3 percent ... Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION

- Less than 25 percent of topsoil removed
- 25 to 75 percent of topsoil removed (on soil group 1, 25 to 50 percent of topsoil removed)
- 50 to 75 percent of topsoil removed (used only on soil group 2)
- 75 percent or more of topsoil removed, or all topsoil and some subsoil removed
- 5 All topsoil and most or all of subsoil removed, parent material may be exposed or eroded

GULLY EROSION

- 7 Occasional gullies. More than 100 feet apart
- 8 Frequent gullies: Occurring less than 100 feet apart, but including less than 75 percent of area delineated
- 9 Very frequent gullies
- ⌣ Indicates gullies too deep to be crossed with tillage implements, as 7̑, 8̑, or 9̑
- \+ Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
C	6 to 8
D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Erosion symbol	Approximate depth in inches to: Parent material in soil group 1a	1b	B horizon in soil group 2
2	60 or more	36 or more	12 or more
3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT
- a Normal profile
  - 1 Houston black clay
  - Houston black clay, gravelly phase
  - 3 Houston Hunt clay
  - 4 Houston black clay, saline phase
- Shallow to parent material
  - 5 Houston black clay, shallow phase
  - 6 Houston black clay, shallow phase over chalk
  - 7 Austin clay, shallow phase
  - 8 Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA
- a · Dense on drying
  - 9 Wilson clay
  - 10 Wilson clay loam
  - 11 · Wilson fine sandy loam
- b · Moderately friable
  - 12 · Crockett clay loam
  - 13 · Crockett fine sandy loam

3-COLLUVIAL SOILS
- 14 · Houston-Hunt clay, colluvial phase
- 15 · Wilson clay, colluvial phase
- 16 · Wilson clay loam, colluvial phase
- 17 · Wilson fine sandy loam, colluvial phase
- 18 · Crockett clay loam, colluvial phase
- 19 · Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS
- 20 · Trinity clay
- 21 · Catalpa clay
- 22 · Kaufman clay
- 23 · Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads · Dirt (good motor)

Dirt (poor motor or private)

Bridge

Culvert

Buildings

Church

School

Dams

DRAINAGE

Perennial streams

Intermittent streams

Ditches

Perennial lakes

Sinks

HYDROLOGIC

Gaging station

Runoff measuring station and silt box

Standard rain gage

Recording rain gage

Meteorological station

Standard rain gage and temperature station

Recording rain gage and temperature station

Recording rain gage, temperature and wind station

Nonrecording ground-water well

Recording ground-water well

Small watershed boundary

Watershed boundary

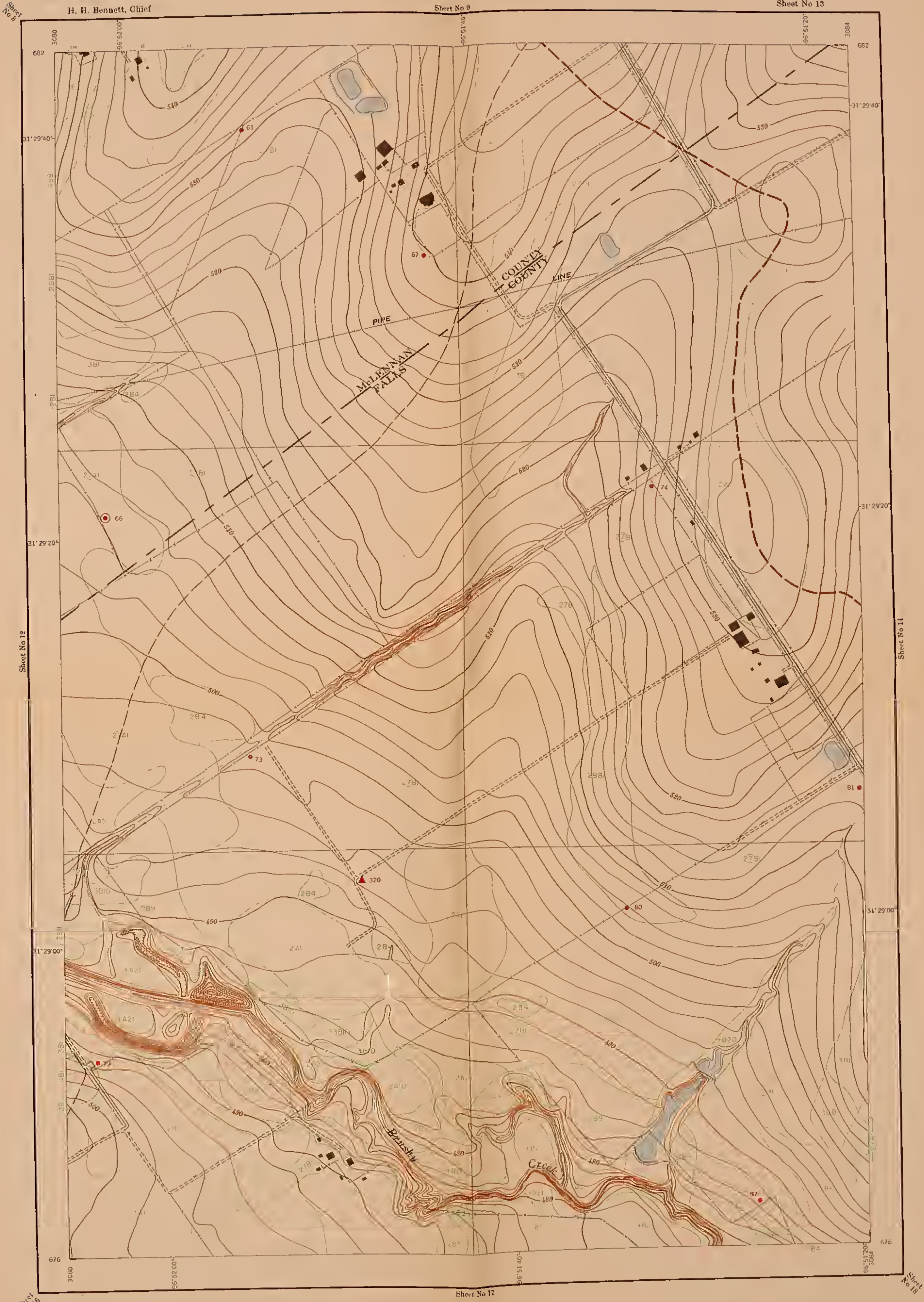
Project boundary

TEXAS

BLACKLANDS
EXPERIMENTAL WATERSHED

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

McLENNAN AND FALLS COUNTIES



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Polyconic projection North American 1927 datum indicated by marginal ticks.
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

1°47'05' S. W. corner of map
91'
True North
Magnetic North

Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

37B5

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
B - slope, 1 to 3 percent   5 - Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION
- 2 - Less than 25 percent of topsoil removed
- 3 - 25 to 75 percent of topsoil removed (on soil group 2, 25 to 50 percent of topsoil removed)
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GULLY EROSION
- 7 - Occasional gullies: More than 100 feet apart
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- 9 - Very frequent gullies
- ◡ - Indicates gullies too deep to be crossed with tillage implements, as 7, 8, or 9

+ - Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
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DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Erosion symbol	Approximate depth in inches to: Parent material in soil group 1a	1b	B horizon in soil group 2
2	60 or more	36 or more	12 or more
3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT
- a - Normal profile
  - 1 - Houston black clay
  - 2 - Houston black clay, gravelly phase
  - 3 - Houston-Hunt clay
  - 4 - Houston black clay, saline phase
- b - Shallow to parent material
  - 5 - Houston black clay, shallow phase
  - 6 - Houston black clay, shallow phase over chalk
  - 7 - Austin clay, shallow phase
  - 8 - Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA
- a - Dense on drying
  - 9 - Wilson clay
  - 10 - Wilson clay loam
  - 11 - Wilson fine sandy loam
- b - Moderately friable
  - 12 - Crockett clay loam
  - 13 - Crockett fine sandy loam

3-COLLUVIAL SOILS
- 14 - Houston-Hunt clay, colluvial phase
- 15 - Wilson clay, colluvial phase
- 16 - Wilson clay loam, colluvial-phase
- 17 - Wilson fine sandy loam, colluvial phase
- 18 - Crockett clay loam, colluvial phase
- 19 - Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS
- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

- Roads - Dirt (good motor)
- Dirt (poor motor or private)
- Bridge
- Culvert
- Buildings
- Church
- School
- Dams

DRAINAGE

- Perennial streams
- Intermittent streams
- Ditches
- Perennial lakes
- Sinks

HYDROLOGIC

- Gaging station
- Runoff measuring station and silt box
- Standard rain gage
- Recording rain gage
- Meteorological station
- Standard rain gage and temperature station
- Recording rain gage and temperature station
- Recording rain gage, temperature and wind station
- Nonrecording ground-water well
- Recording ground-water well
- Small watershed boundary
- Watershed boundary
- Project boundary

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

FALLS COUNTY
Sheet No 14

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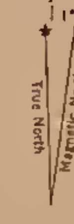
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800
200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment



Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

BLACKLANDS EXPERIMENTAL WATERSHED

Sheet No.14

LEGEND

EXPLANATION OF SYMBOL

3785

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies

8 - slope, 1 to 3 percent   5 - Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION

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- 3 - 25 to 75 percent of topsoil removed (on soil group 2, 25 to 50 percent of topsoil removed)
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+ - Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
C	6 to 8
D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

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3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT

- a - Normal profile
  - 1 - Houston black clay
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  - 6 Houston black clay, shallow phase over chalk
  - 7 Austin clay, shallow phase
  - 8 Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA

- a - Dense on drying
  - 9 Wilson clay
  - 10 - Wilson clay loam
  - 11 - Wilson fine sandy loam
- b - Moderately friable
  - 12 - Crockett clay loam
  - 13 Crockett fine sandy loam

3-COLLUVIAL SOILS

- 14 - Houston-Hunt clay, colluvial phase
- 15 Wilson clay, colluvial phase
- 16 Wilson clay loam, colluvial phase
- 17 Wilson fine sandy loam, colluvial phase
- 18 - Crockett clay loam, colluvial phase
- 19 - Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS

- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads Dirt (good motor)

Dirt (poor motor or private)

Bridge

Culvert

Buildings

Church   School

Dams

DRAINAGE

Perennial streams

Intermittent streams

Ditches

Perennial lakes

Sinks

HYDROLOGIC

Gaging station

Runoff measuring station and silt box

Standard rain gage

Recording rain gage

Meteorological station

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Recording rain gage and temperature station

Recording rain gage, temperature and wind station

Nonrecording ground-water well

Recording ground-water well

Small watershed boundary

Watershed boundary

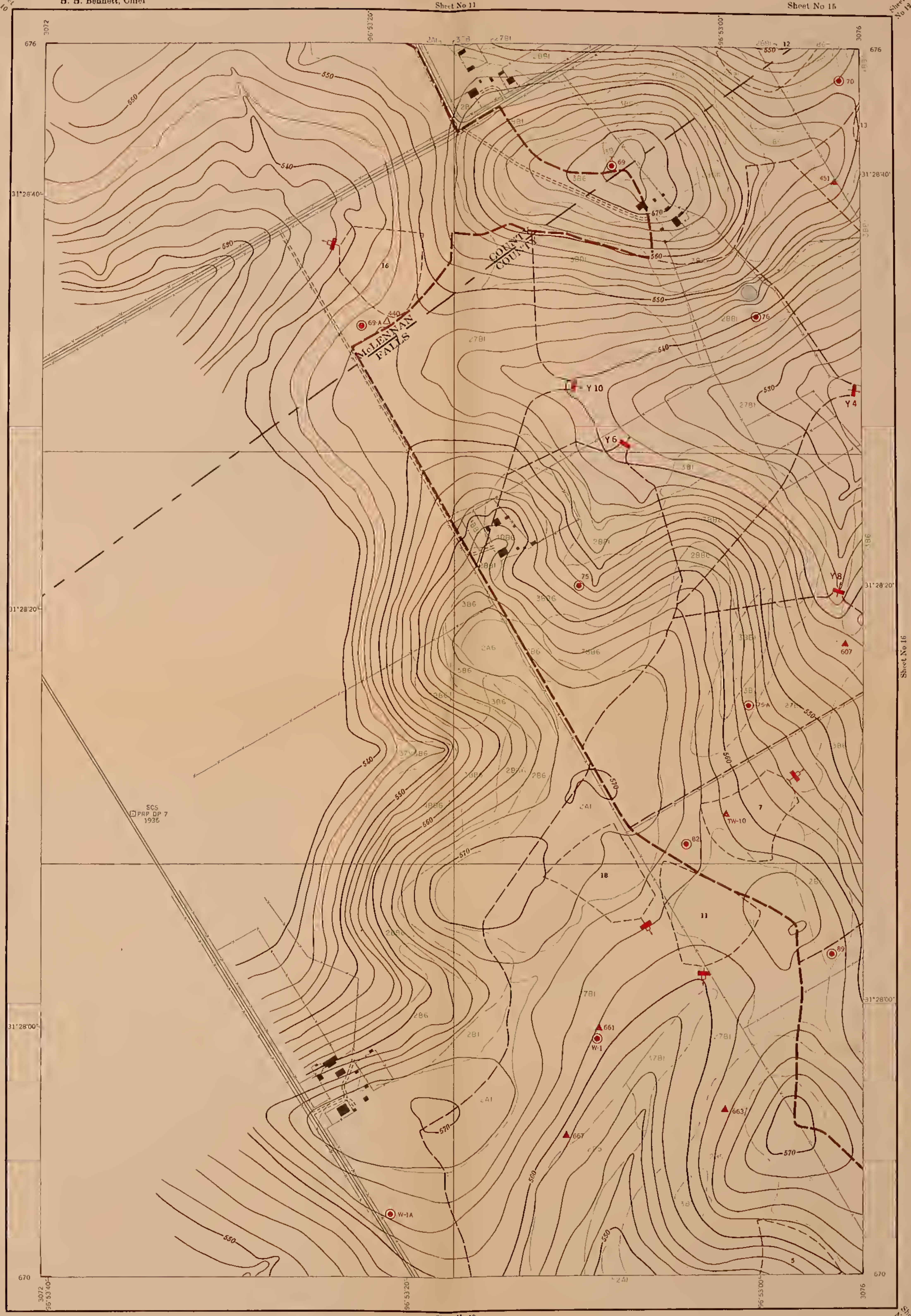
Project boundary

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS

BLACKLANDS
EXPERIMENTAL WATERSHED

McLENNAN AND FALLS COUNTIES



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Hydrologic Division-Research C. E. Remser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

1°46'17" S. W. corner of map
9½°
True North
Magnetic North

Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

BLACKLANDS EXPERIMENTAL WATERSHED

Sheet No.15

LEGEND

EXPLANATION OF SYMBOL

3785

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
8 - slope, 1 to 3 percent   5 - Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION

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SLOPE

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C	6 to 8
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DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

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3	36 to 60	12 to 36	8 to 12
33	--	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT

- a - Normal profile
  - 1 - Houston black clay
  - 2 - Houston black clay, gravelly phase
  - 3 - Houston-Hunt clay
  - 4 - Houston black clay, saline phase
- b - Shallow to parent material
  - 5 - Houston black clay, shallow phase
  - 6 - Houston black clay, shallow phase over chalk
  - 7 - Austin clay, shallow phase
  - 8 - Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA

- a - Dense on drying
  - 9 - Wilson clay
  - 10 - Wilson clay loam
  - 11 - Wilson fine sandy loam
- b - Moderately friable
  - 12 - Crockett clay loam
  - 13 - Crockett fine sandy loam

3-COLLUVIAL SOILS

- 14 - Houston-Hunt clay, colluvial phase
- 15 - Wilson clay, colluvial phase
- 16 - Wilson clay loam, colluvial phase
- 17 - Wilson fine sandy loam, colluvial phase
- 18 - Crockett clay loam, colluvial phase
- 19 - Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS

- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads - Dirt (good motor)

Dirt (poor motor or private)

Bridge

Culvert

Buildings

Church   School

Dams

DRAINAGE

Perennial streams

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Gaging station

Runoff measuring station and silt box

Standard rain gage

Recording rain gage

Meteorological station

Standard rain gage and temperature station

Recording rain gage and temperature station

Recording rain gage, temperature and wind station

Nonrecording ground-water well

Recording ground-water well

Small watershed boundary

Watershed boundary

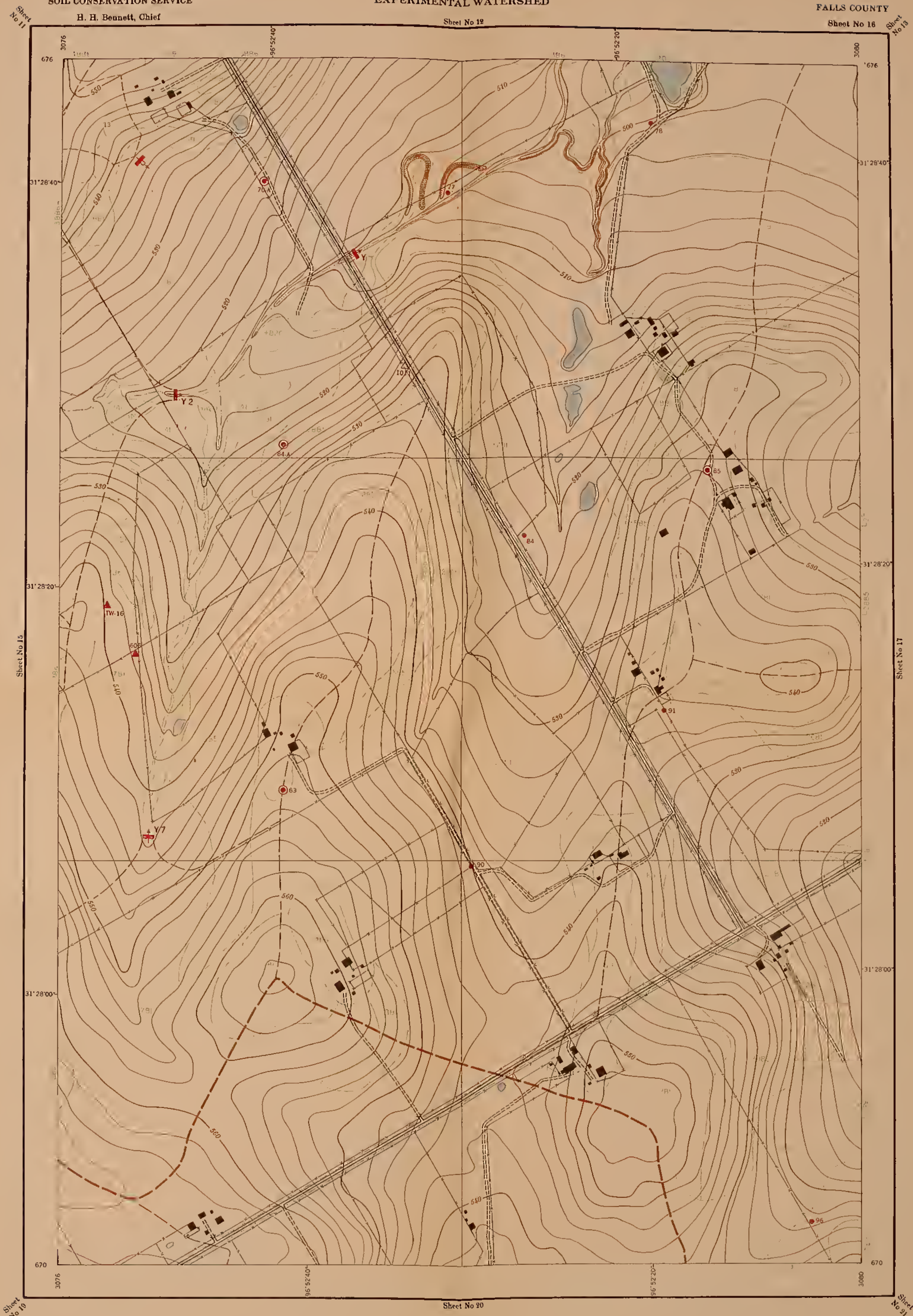
Project boundary

TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

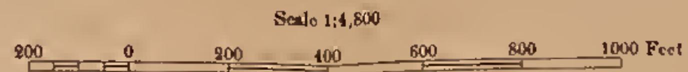
BLACKLANDS
EXPERIMENTAL WATERSHED

FALLS COUNTY

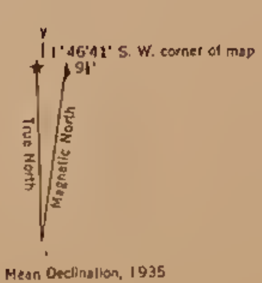


Base map compiled from aerial photographs by Soil Conservation Service, 1941.
Surveys by Soil Conservation Service, 1938.
Lambert projection. 2000 foot grid based upon Texas system (Central Zone) of plane coordinates with last three digits of grid numbers omitted.
Polyconic projection. North American 1927 datum indicated by marginal ticks.
Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800



Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment



Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

3785

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
8 - slope, 1 to 3 percent 5 - Soil type, Houston black clay, shallow phase

EROSION

SHEET EROSION

- 2 - Less than 25 percent of topsoil removed
- 3 - 25 to 75 percent of topsoil removed (on soil group 2, 25 to 50 percent of topsoil removed)
- 33 - 50 to 75 percent of topsoil removed (used only on soil group 2)
- 4 - 75 percent or more of topsoil removed, or all topsoil and some subsoil removed
- 5 - All topsoil and most or all of subsoil removed; parent material may be exposed or eroded

GULLY EROSION

- 7 - Occasional gullies: More than 100 feet apart
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- 9 - Very frequent gullies
- ⌒ - Indicates gullies too deep to be crossed with tillage implements, as $\overset{\frown}{7}$, $\overset{\frown}{8}$, or $\overset{\frown}{9}$

+ - Recent deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
A	Less than 1
B	1 to 3
BB	3 to 6
C	6 to 8
D	8 and over

DEPTH OF SOIL IN SOIL GROUPS 1 AND 2

Approximate depth in inches to :

Erosion symbol	Parent material in soil group 1a	Parent material in soil group 1b	B horizon in soil group 2
2	60 or more	36 or more	12 or more
3	36 to 60	12 to 36	8 to 12
33	—	—	4 to 8
4	12 to 36	0 to 12	0 to 4
5	0 to 12	0	—

SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT

- a - Normal profile
  - 1 - Houston black clay
  - 2 - Houston black clay, gravelly phase
  - 3 - Houston Hunt clay
  - 4 - Houston black clay, saline phase
- b - Shallow to parent material
  - 5 - Houston black clay, shallow phase
  - 6 - Houston black clay, shallow phase over chalk
  - 7 - Austin clay, shallow phase
  - 8 - Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA

- a - Dense on drying
  - 9 - Wilson clay
  - 10 - Wilson clay loam
  - 11 - Wilson fine sandy loam
- b - Moderately friable
  - 12 - Crockett clay loam
  - 13 - Crockett fine sandy loam

3-COLLUVIAL SOILS

- 14 - Houston-Hunt clay, colluvial phase
- 15 - Wilson clay, colluvial phase
- 16 - Wilson clay loam, colluvial phase
- 17 - Wilson fine sandy loam, colluvial phase
- 18 - Crockett clay loam, colluvial phase
- 19 - Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS

- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads - Dirt (good motor)

Dirt (poor motor or private)

Bridge

Culvert

Buildings

Church

School

Dams

DRAINAGE

Perennial streams

Intermittent streams

Ditches

Perennial lakes

Sinks

HYDROLOGIC

Gaging station

Runoff measuring station and silt box

Standard rain gage

Recording rain gage

Meteorological station

Standard rain gage and temperature station

Recording rain gage and temperature station

Recording rain gage, temperature and wind station

Nonrecording ground-water well

Recording ground-water well

Small watershed boundary

Watershed boundary

Project boundary

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

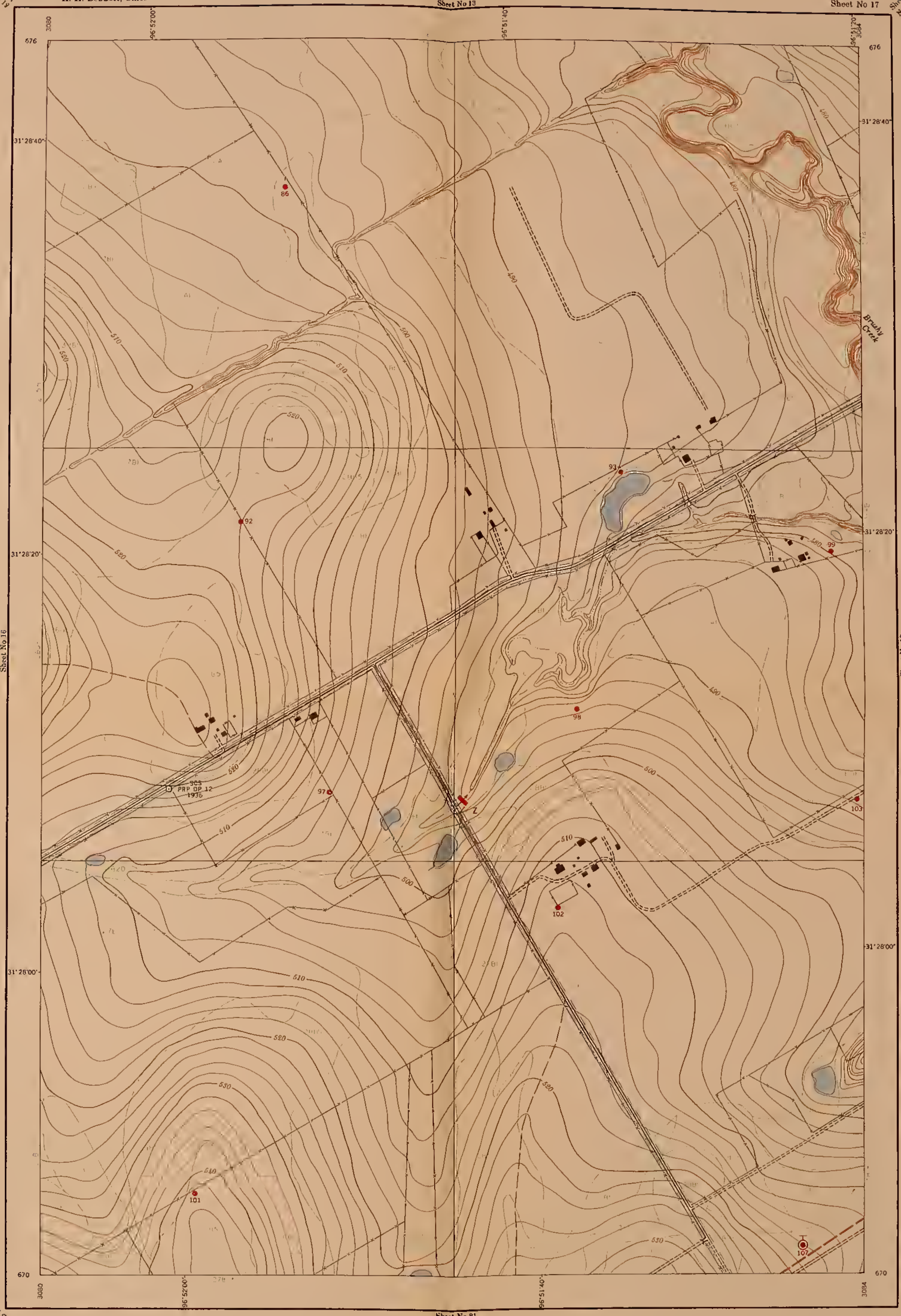
H. H. Bennett, Chief

TEXAS

BLACKLANDS

EXPERIMENTAL WATERSHED

FALLS COUNTY



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Polyconic projection. North American 1927 datum
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Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800

200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

Y

1°47'04' S. W. corner of map

9½'

True North

Magnetic North

Approximate Mean Declination, 1935

Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

37B5

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
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EROSION

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SLOPE

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SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT

- a Normal profile
  - 1 Houston black clay
  - 2 Houston black clay, gravelly phase
  - 3 Houston-Hunt clay
  - 4 Houston black clay, [illegible] phase
- b Shallow to parent material
  - 5 Houston black clay, shallow phase
  - 6 Houston black clay, shallow phase over chalk
  - 7 - Austin clay, shallow phase
  - 8 Chalk outcrop

2 PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA

- a - Dense on drying
  - 9 - Wilson clay
  - 10 - Wilson clay loam
  - 11 Wilson fine sandy loam
- b Moderately friable
  - 12 - Crockett clay loam
  - 13 - Crockett fine sandy loam

3 COLLUVIAL SOILS

- 14 - Houston-Hunt clay, colluvial phase
- 15 Wilson clay, colluvial phase
- 16 Wilson clay loam, colluvial phase
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- 18 Crockett clay loam, colluvial phase
- 19 Crockett fine sandy loam, colluvial phase

4 ALLUVIAL SOILS

- 20 Trinity clay
- 21 Catalpa clay
- 22 Kaufman clay
- 23 Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

- Roads - Dirt (good motor)
- Dirt (poor motor or private)
- Bridge
- Culvert
- Buildings
- Church
- School
- Dams

DRAINAGE

- Perennial streams
- Intermittent streams
- Ditches
- Perennial lakes
- Sinks

HYDROLOGIC

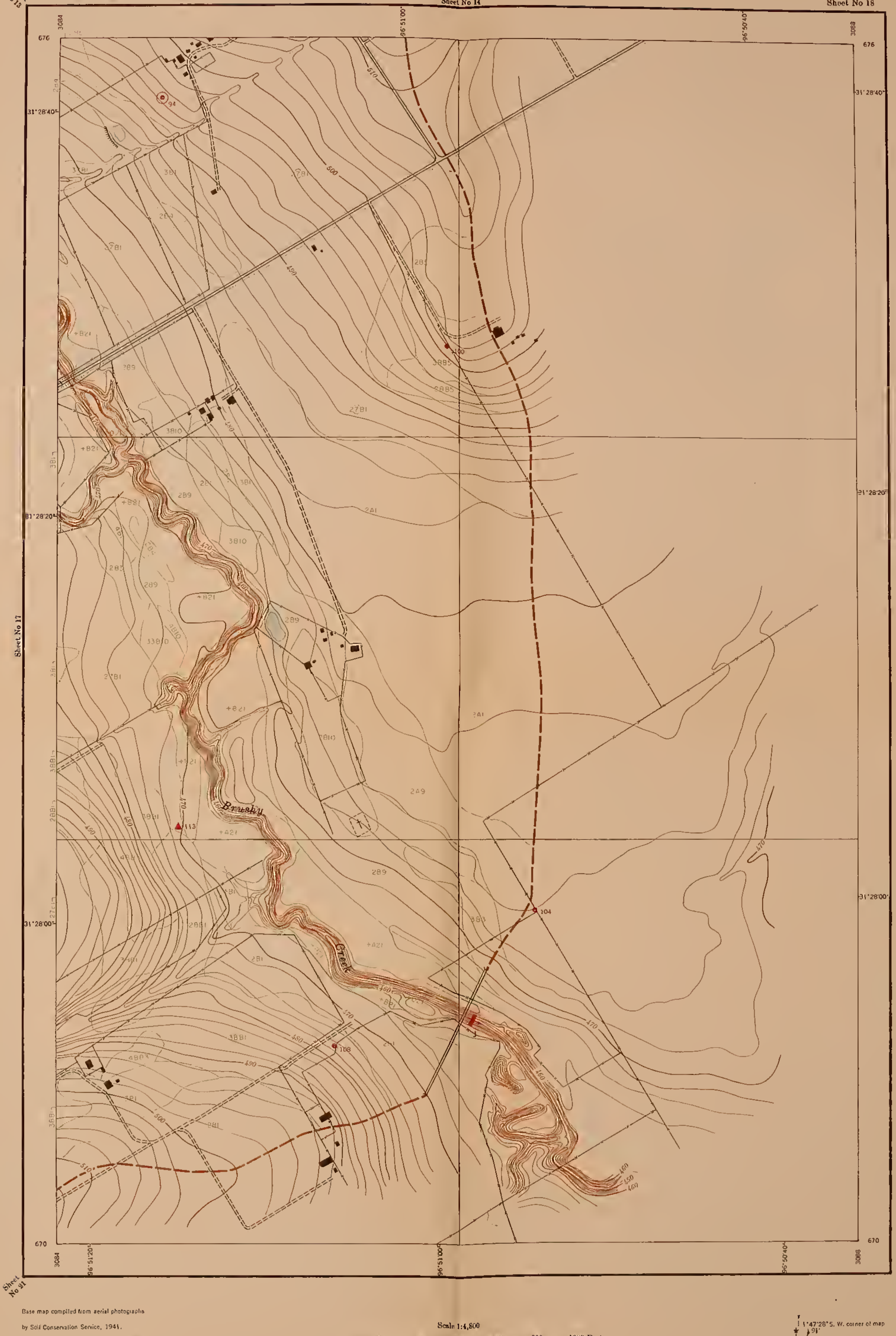
- Gaging station
- Runoff measuring station and silt box
- Standard rain gage
- Recording rain gage
- Meteorological station
- Standard rain gage and temperature station
- Recording rain gage and temperature station
- Recording rain gage, temperature and wind station
- Nonrecording ground-water well
- Recording ground-water well
- Small watershed boundary
- Watershed boundary
- Project boundary

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

FALLS COUNTY
Sheet No 18

Sheet No 14



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Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800
200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

1°47'28" S. W. corner of map
91'
True North
Magnetic North
Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

37B5

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2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA
- a - Dense on drying
  - 9 - Wilson clay
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4-ALLUVIAL SOILS
- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
- 23 - Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

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Dirt (poor motor or private)

Bridge

Culvert

Buildings

Church

School

Dams

DRAINAGE

Perennial streams

Intermittent streams

Ditches

Perennial lakes

Sinks

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Runoff measuring station and silt box

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Recording rain gage

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Recording rain gage and temperature station

Recording rain gage, temperature and wind station

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Recording ground-water well

Small watershed boundary

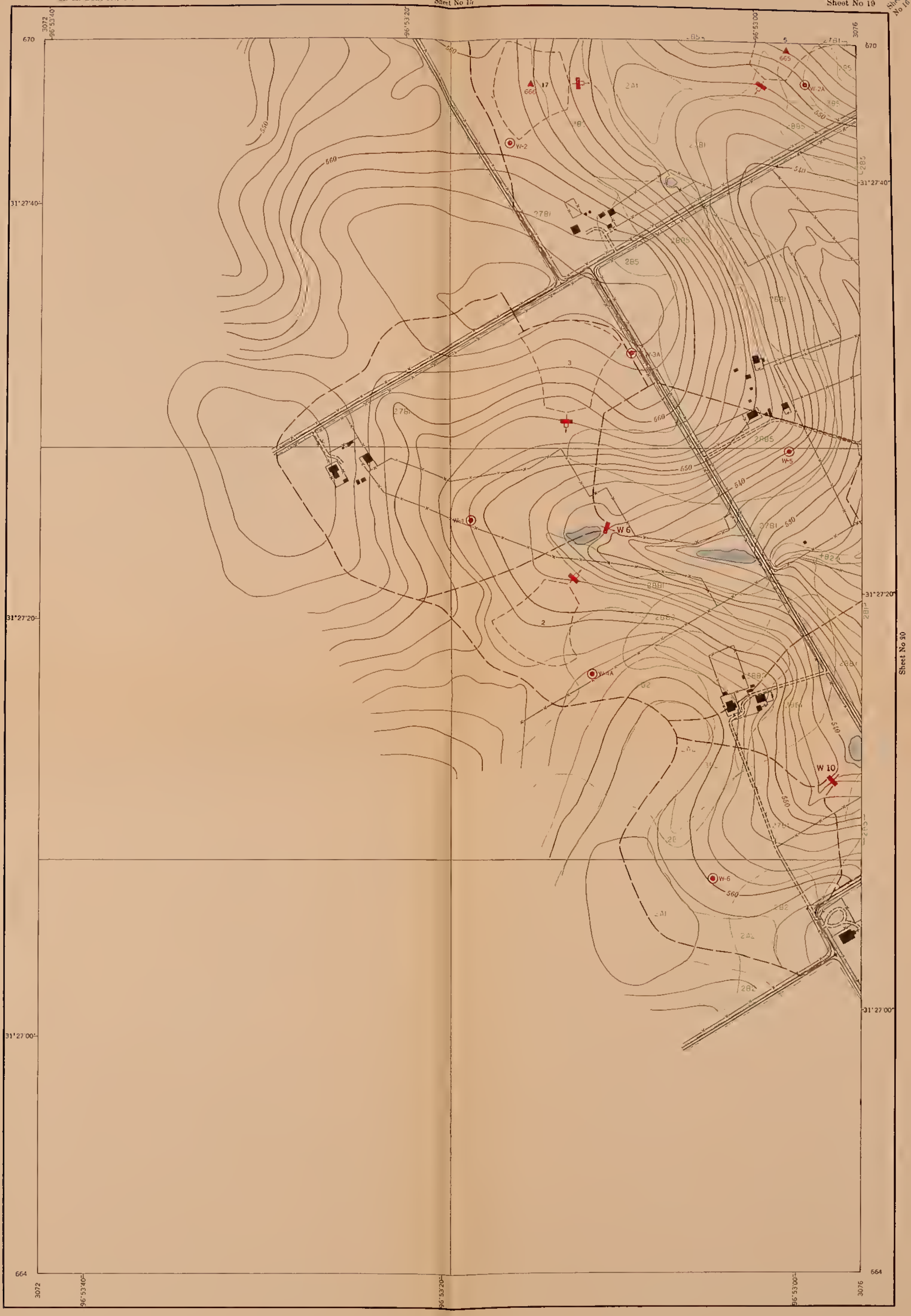
Watershed boundary

Project boundary

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

FALLS COUNTY
Sheet No 19



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Hydrologic Division-Research C. E. Ramser, Chief

Scale 1:4,800
200 0 200 400 600 800 1000 Feet

Contour interval 2 feet
Datum is mean sea level
Elevations based upon 1929 General Adjustment

Y
1°46'15" S. W. corner of map
91'
True North
Magnetic North

Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

37B5

37 · Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
8 · slope, 1 to 3 percent   5 · Soil type, Houston black clay, shallow phase

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SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
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SOILS

1-PRAIRIE SOILS, GRANULAR STRUCTURE, ALKALINE THROUGHOUT

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- 2 · Houston black clay, gravelly phase
- 3 · Houston-Hunt clay
- 4 · Houston black clay, [illegible] phase

b · Shallow to parent material
- 5 · Houston black clay, shallow phase
- 6 · Houston black clay, shallow phase over chalk
- 7 · Austin clay, shallow phase
- 8 · Chalk outcrop

2-PRAIRIE SOILS, MODERATELY CALCAREOUS SUBSTRATA

a · Dense on drying
- 9 · Wilson clay
- 10 · Wilson clay loam
- 11 · Wilson fine sandy loam

b · Moderately friable
- 12 · Crockett clay loam
- 13 · Crockett fine sandy loam

3-COLLUVIAL SOILS
- 14 · Houston-Hunt clay, colluvial phase
- 15 · Wilson clay, colluvial phase
- 16 · Wilson clay loam, colluvial phase
- 17 · Wilson fine sandy loam, colluvial phase
- 18 · Crockett clay loam, colluvial phase
- 19 · Crockett fine sandy loam, colluvial phase

4-ALLUVIAL SOILS
- 20 · Trinity clay
- 21 · Catalpa clay
- 22 · Kaufman clay
- 23 · Kaufman fine sandy loam

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Roads · Dirt (good motor)
Dirt (poor motor or private)
Bridge
Culvert
Buildings
Church   School
Dams

DRAINAGE

Perennial streams
Intermittent streams
Ditches
Perennial lakes
Sinks

HYDROLOGIC

Gaging station
Runoff measuring station and silt box
Standard rain gage
Recording rain gage
Meteorological station
Standard rain gage and temperature station
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Watershed boundary
Project boundary

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

FALLS COUNTY

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1°46'39" S. W. corner of map
91°
True North
Magnetic North
Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

LEGEND

EXPLANATION OF SYMBOL

37B5

37 - Moderate erosion, 25 to 75 percent of topsoil removed and occasional gullies
B - slope, 1 to 3 percent   5 - Soil type: Houston black clay, shallow phase

EROSION

SHEET EROSION

[illegible]

GULLY EROSION

[illegible] More than 100 [illegible]

[illegible] Frequent gullies [illegible] than 100 [illegible] but [illegible] than 75 percent of area [illegible]

9 - Very frequent gullies

[illegible] gullies [illegible] be crossed with tillage implements, as 7, 8, or 9

+ [illegible] deposits

SLOPE

SLOPE SYMBOL	DOMINANT PERCENT
[illegible]	Less than 1
B	1 to 3
[illegible]	3 to 5
[illegible]	5 to 8
[illegible]	8 and over

DEPTH OF [illegible] SOIL GROUPS [illegible]

Approximate depth in inches [illegible]

Group [illegible]	Parent material in soil group [illegible]	[illegible]	horizon in group [illegible]
[illegible]	[illegible] more	more	[illegible]
[illegible]	36 to 60	[illegible] 36	8 [illegible] 2
3	—	[illegible]	[illegible]
[illegible]	[illegible] to 36	0 [illegible] 12	
[illegible]	0 to 1[illegible]	[illegible]	

SOILS

PRAIRIE SOILS [illegible] STRUCTURE [illegible]

[illegible]

PRAIRIE SOILS [illegible]

[illegible] Wilson [illegible]

11 - Wilson [illegible]

b - Moderately [illegible]

12 - Crockett clay loam

Crockett fine sandy loam

COLLUVIAL SOILS

14 - Houston Hunt clay, colluvial phase

15 - Wilson clay, colluvial phase

1[illegible] - Wilson clay loam, colluvial phase

Wilson fine sandy loam, colluvial phase

18 - Crockett clay loam, colluvial phase

19 - Crockett fine sandy loam, colluvial phase

ALLUVIAL SOILS

[illegible]0 - Trinity clay

[illegible]1 - Catalpa clay

[illegible]2 - Kaufman clay

[illegible]

GEOGRAPHIC SYMBOLS

WORKS AND STRUCTURES

Road [illegible] (good motor)

[illegible]

DRAINAGE

Perennial stream

[illegible]

HYDROLOGIC

[illegible]

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

TEXAS
BLACKLANDS
EXPERIMENTAL WATERSHED

FALLS COUNTY
Sheet No 21

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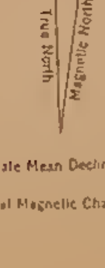

Approximate Mean Declination, 1935
Annual Magnetic Change 2'E

BLACKLANDS EXPERIMENTAL WATERSHED

Sheet No. 21

LEGEND

EXPLANATION OF SYMBOL

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4-ALLUVIAL SOILS

- 20 - Trinity clay
- 21 - Catalpa clay
- 22 - Kaufman clay
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